
SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
FIAT LVX
MDCCCLXVIII
EX LIBRIS

30

No. 1. July, 1923. Vol. XLI.

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTED BY

LIEUTENANT-COLONEL A. E. HAMERTON, C.M.G., D.S.O., R.A.M.C.

ISSUED MONTHLY

IN ARDUIS FIDELIS

Printed and Published by
JOHN BALE, SONS & DANIELSSON, LTD.
OXFORD HOUSE
83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.
Price Two Shillings net.

Journal

of the

Royal Army Medical Corps

Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTED BY

COLONEL D. HARVEY, C.M.G., C.B.E., R.A.M.C.

VOL. XLI.

July—December, 1923.

JOHN BALE, SONS & DANIELSSON, LTD.
OXFORD HOUSE
83-91, GREAT TITCHFIELD STREET, OXFORD STREET, W. 1.

VOLUME XLI. JULY, 1923. No. 1.

Journal of the Royal Army Medical Corps.

Original Communications.

MARS HYGEAQUE.

BY MAJOR M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

I.

THE Great War was stated to be a war to end war. Let us hope that this may prove to be true. If not, it may have been a war to accelerate the end of war. But for some generations to come war must remain a perpetual nightmare to civilization. Nations are still thinking in terms of war, and in all countries many clever men are devoting their abilities to its study. It has become a complex subject closely interwoven with most branches of scientific progress, and also with commerce and industry. Mars has become head of a big Combine. Into this combine, as an important factor of future warfare, the science of medicine has been incorporated.

II.

The science of medicine assists a force to obtain victory, yet unlike other military measures it does so by preserving life instead of destroying it. The preventive and curative functions of a medical service, functions with a high military potentiality, can be applied with equal benefit to mankind in general. The latter has already benefited by the medical discoveries made in peace time in the interests of war, and during the course of the more recent wars. In the hideous balance sheet of war this is one asset which though relatively small is of lasting world value. Many of the blessings of medical science, unreckoned and perhaps unreckonable, result from the accelerated advance in our knowledge of disease and its prevention, and of medical and surgical treatment, which takes place when the

medical services of contending Powers are separately engaged in combating disease in the interests of the armed forces to which they belong.

III.

Let us consider the rôle of a medical service in war. It performs two principal functions, the first to prevent disease, the second to heal the sick and wounded. The first function aims at keeping each individual member of a force free from preventable disabilities, healthy and effective ; in other words, its aim is "to keep rifles in the firing line." The second function, to heal the sick and wounded, has to a great extent a similar aim. With the minor cases of sickness (a large proportion of the total sick) it can succeed where prevention has failed; with the slightly wounded (also a large proportion of the total numbers wounded) it can succeed in diminishing the effects of enemy weapons by returning a considerable percentage to duty, provided that its methods and organization are efficient. The whole of the work of a medical service is humanitarian, but three-quarters of it is of immense military value as well. An efficient medical service not only improves the *moral* of troops, but it effects far-reaching military measures such as the conservation of man-power, the reduction of non-effectives, and economies in money and material, the combination of which in the latter stages of a protracted war may lead to victory in the field. It is necessary to get a completely new conception of the rôle to be played by the medical profession in warfare; the altered relationship of medicine to war affects the future of the medical services and the individual medical officer. It affects the future of the Geneva Convention also.

IV.

In the past the military medical officer was a practitioner who attended the troops in peace and war. This was all that was required of him, as disease prevention was practically unknown. He was in a state of administrative serfdom. With the rise of medical science, the rôle of the medical officer expanded, until at the present day he is a practitioner plus highly trained sanitary expert, whose advice is sought for and acted upon with regard to every matter which may have an influence on the health of troops in peace and war. In the future he is likely to become still more important in the military machine, and develop duties which will make him an administrative military officer. As nations begin to realize that the science of medicine is linked up to the art of war they will not be content with the limited value they obtain, and can only hope to obtain, from their medical services as long as these services remain advisory in their functions. Administrative medicine and hygiene deal with many branches of what is called "Q" work, the feeding, the housing, the clothing of the soldier, conservancy, water supply, bathing, laundries and other matters besides. To get maximum results the adviser must turn to executive work and cease giving advice only. (Ordinary common sense tells us that if one pays a

boy to look after a car it is best to get him to do the job himself, and not have him sitting on a chair in the garage giving advice while one lies uncomfortably underneath trying to carry out his instructions.) It is probable that in future men with medical qualifications will begin to study war in all its branches at military schools in order that the teachings of preventive medicine can be better applied. The tendency may be towards giving the medical officer more and more executive responsibility until the greater part of "Q" duties rests in his hands. Instead of being an expert who attends Board meetings to give his technical advice, he will join the Board of Directors. Hygiene may become "Q."

V.

Let us examine the present field sanitary organization of a unit in the British Army. The commanding officer is responsible for the sanitation of his battalion, that is to say, for such matters as the provision of satisfactory conservancy arrangements and the efficient supervision of these, in order that they may not become centres of infection and so spread disease among the troops. He obtains materials for erecting conservancy structures from two sources; screens and receptacles from Ordnance, timber from the Engineers. The medical officer advises him as to the sites which should be selected and the types of sanitary appliances required. The commanding officer then arranges for the work to be carried out. He may have no carpenters—tools are at a premium on field service—and he may get assistance from the Royal Engineers. Thus there are four services concerned in the erection of a conservancy structure, and the service which knows what is required merely gives advice.

VI.

"Sanitation" was nursed in penury. Most of its childhood was passed in India at a time when funds were rarely available for new-fangled ideas, as sanitation then was, what the late Sir Victor Horsley called "financial terrorism in times of peace." It is still inclined to be penuriously-minded, in that its appliances are constructed from the leavings of other services such as empty ration boxes, oil drums and petrol tins. Good sanitation is largely a matter of amateur carpentry, if tools are available. A unit does not carry its essential sanitary appliances with it, nor are these stocked by Ordnance. They have to be constructed on the spot from such materials as can be obtained or "scrounged" in the locality.

VII.

The results obtained by this system are surprisingly satisfactory. Commanding officers are keen "sanitarians" and medical officers give more than their advice; they are "all out" to help. Friction is rare and the sanitary condition of British lines is soon made as good as can be expected. Yet the system is complicated and wasteful in energy and it is likely to

be simplified as the importance of sanitation in war becomes more recognized. Sanitary appliances, portable and properly made, will be constructed in peace time and stocked ready for issue on a definite scale to troops. ("The Manual of Military Hygiene" contains sufficient details and diagrams to enable this to be done now.) Improvised methods and materials will not be considered good enough for the future; eventually the whole of unit sanitation, its provision, maintenance and organization, is likely to become the duty of a specially trained and equipped sanitary service, of which the present "sanitary section" is the forerunner.

VIII.

Water points on field service are selected by staff officers, on the advice of medical and engineer officers. The only official water receptacle in which water can be purified by chlorination (exclusive of water bottles and camp kettles) is the 110 gallon water cart, issued to field units on a scale of one per company or similar body of men. Smaller units, and those which do not form part of the field force, are not normally provided with a water cart. There is no smaller receptacle available in sufficient quantity for such units. The index on which water receptacles should be issued is the number of mouths to be fed, irrespective of the size and function of the units to which the owners of the mouths belong. In the future, very elaborate arrangements will probably be made to ensure an adequate supply of purified water to every man in a force, soldier or follower.

IX.

A medical officer makes frequent sanitary inspections. He writes many reports, and brings to notice any sanitary defects which he finds at his inspections. Rarely does it happen that his sanitary recommendations are not attended to, but should there be any glaring defect, he is presumed to be protected from blame if he has represented the defect on paper. (As a rule, his armour being of paper only is easily pierced.) The practice of hygiene requires many reports—more than other branches of medicine—the reason being, presumably, that hygiene is an advisory service, and the advice is committed to paper in order that responsibility for non-compliance with sanitary recommendations can be traced. It is probably the only service in the British Army which functions in this manner. No one writes to a battery commander and advises him how to fire his guns. Why does a sanitary officer advise? Because he has always done so. The riddle appears to have no other answer.

X.

The existing organization of sanitation, with the responsibility for execution devolving on the commanding officer, and for recommendations on the medical officer, may be quite satisfactory and yield good results. When it was brought into operation in the early days of military hygiene,

many years before the Great War, it was the most workable system which could have been introduced. It succeeded in making the regimental officers keen on this subject. The acme of an efficient unit was good regimental sanitation. Nevertheless, it is unlikely to last except in a much more limited degree. A high standard of sanitation in a force takes not only time but a good deal of co-operation. Many branches have to be consulted and cajoled, with consequent delay, at a time when the force requires to concentrate its thoughts and its efforts on overcoming its opponents. Essential sanitary work has to be carried out by services which also deal with offensive and defensive construction. The latter takes priority over everything. Sanitation will be made "automatic." The high commands of European armies must eventually hand it over, lock, stock and barrel, to a specially trained and adequately equipped unit which can see the whole thing through without consulting other departments. Sanitary reports and recommendations will cease; "hygiene" will tackle the whole problem and reach a far higher standard than the present by carrying out the work itself.

XI.

During the Great War when the British medical profession was "mobilized," there was a broad division of duties between the temporary officer and the regular officer. The temporary officer took over the professional work, the regular officer administration; each was thus performing the work he knew most about. The civil profession has little opportunity for administrative training—busy practitioners, for example, having next to none. Many were capable administrators, but it was due to a natural gift rather than to peace-time experience. For the civil profession at the present day appears to be even more "advisory" in its functions than the medical services. The community in its relation to the medical profession is like a motor owner who pays a chauffeur to stand on the footboard of the car and shout advice to someone in the driving seat. The civil profession will eventually take up administration and go in more for public work—Parliament, County Councils and the like. Law is at present the ruling profession; in the future medicine may supplant it. Medical administration is probably the most important branch of the profession; it aims at applying the benefit of medical knowledge to the community at large, in order to guard that community from disease and at the same time ensure that the most up-to-date and efficient treatment is available for those who are ill. A careless surgeon or physician may lose one patient's life; slack administration may cause the loss of hundreds or thousands of lives.

XII.

The importance of medical administration is perhaps best seen in war. After battles, if lives are to be saved it is on the administrator rather than on the surgeon that the saving depends. Slow collection of wounded, slow

evacuation, congested hospitals, lack of sufficient personnel at the proper place, lack of shelter and food, shortage of surgical material—these and similar administration errors if committed would cause far more loss of life than incompetent surgery. Of what use is a skilled surgeon if he is sent to the wrong place, if his patients reach him in a moribund condition, or die after operation from exposure? The administrator more than the surgeon must be perfect. And medical administration in a community in peace is as important as it is in an army in war.

XIII.

It is only too obvious that the known facts of medical science as they stand at the present day are not yet fully applied to the benefit of mankind. Other causes, financial and economic, prevent their application, but the principal cause is the "advisory" position of the medical profession and the little attention which medical administration receives. The laity no longer thinks of the doctor in terms of his bedside manner or associates him with faddism. Slowly it begins to associate him with social progress, with the advancement of civilization. For the ultimate aim of social progress, of the levelling-up of the masses to higher standards of living, is largely "health" in its many aspects. Eventually the profession must cross the bridge from advisory to executive duties; the medical man with experience of public affairs, and with the wider mental horizon which results from such experience, will be invaluable to a progressive nation. The medical services of armies may be the first to cross the bridge.

XIV.

With regard to the Field Medical organization of armed forces in the future, before any outline of probable developments can be determined, it is necessary to get some idea of the composition of these armed forces themselves. At present this cannot be done. In future, can bodies of men organized in divisions, brigades and battalions, with guns and transport, march along roads in an advance or retirement, as they have done through history—or will this be impossible?

XV.

The evolution of armies is slow. There is much resemblance in organization between the armies of Roman times and those of to-day. There is a great similarity in organization between the armies which Wellington led through Cambrai towards Paris in 1815 and that which Haig led through the same town in an opposite direction in 1918. One school of thought considers that no matter what developments take place in methods of waging war the ultimate deciding factor will still be the individual armed warrior—the man with a lethal weapon in his hand.

XVI.

The evolution of warfare has been accelerated by the application of science and industry, the great revolutionizing factor being aviation. This is in its early youth. The war forced it on and it "outgrew its strength" so to speak. Under the slow and steady nurturing of commerce it will recuperate; before the outbreak of another European conflagration it may have reached adolescence.

XVII.

There are fashions in fighting as variable as in women's clothes. The former (in contrast to the latter) are dictated largely by common sense in order to gain an advantage over an adversary. (Frequently an advantage is gained by the unexpected re-appearance of an old and forgotten fashion.) Common sense will dictate an air policy, and send up the armed forces of a nation into the air, where they can be more effectively employed against an adversary. Unless more adequate means are devised for countering aircraft from the ground, that adversary must at once develop its air arm. Otherwise it cannot hope for victory. The command of the air must become almost the primary objective of a nation at war; without this it cannot impose its will on its opponent. Its land forces can exist only as scattered groups hiding in woods by day. As air weapons become more precise its tanks may be of limited value. Bombed and gassed continuously, its towns, military camps and arsenals untenable, its railroads, roads and bridges damaged or destroyed, victory is denied until it obtains supremacy in the air.

XVIII.

The air may become the future theatre of war, but there will be an intermediate phase conducted on the principles and methods of the Great War, with much elaboration of the air arm and more mechanical and scientific elements employed. The dividing line between the "air age" and the "pre-air age" will be drawn at a date when aviation becomes sufficiently developed to render forces on sea and on land futile in comparison with those in the air.

XIX.

The lines along which medical units of land forces will evolve themselves must be parallel to the lines of evolution of the forces themselves. It is necessary for a medical service to be well informed regarding new warlike inventions and to be *au courant* with military thought and changes in military organization. It must keep a close watch on what the rest of an army is doing. An army has many vestigial organs; on the outbreak of war after a long peace some of the component parts of an army may be of small tactical value. This is a point which requires consideration, namely the importance of making sure that no medical unit has outlived the function for which it was created, and that each type of unit has shed its vestigial equipment and developed its new essentials. The aim

of peace-time preparation must be to create a useful, elastic "taking-off" organization, built upon the experience of previous wars, with up-to-date equipment and transport, fully provided for the probable eventualities for which the force itself has been designed, and capable of rapid adaptation to meet the new conditions of warfare as they begin to materialize.

XX.

Two new types of conveyance will be adopted for ambulance transport—the aeroplane and the tank. The use of the former is too obvious to require discussion, but the medical value of tanks has not yet been recognized, though they were used for the evacuation of casualties during the Great War. Ambulance tanks, vulnerable only from direct hits, and capable of entering gas zones with impunity, may become the mobile advanced dressing stations of the future. It is possible that tanks will eventually succumb to aircraft, as the latter become more heavily armed and precise in marksmanship. Perhaps the tank, distinctively marked, may eventually be used by medical units only. Built as an engine of destruction, it may atone for its youthful frightfulness by devoting its old age to succouring the wounded.

XXI.

In war, surgery has always been the principal work of the profession. During the Great War surgery actually developed into a relay race of methods, one method dropping out and being scrapped as a better took its place. The surgeon has always been considered more important in war than the physician. But bullets are being superseded by gas. Henceforth, the treatment of the majority of battle casualties as well as the sick will be in the province of the physician. The scope of the surgeon will be limited to a small proportion of casualties and to such "peace time" surgery as may occur among the troops. Here is an instance of the topsy-turvy influences of future war; the physician replaces the surgeon. The star of war surgery is setting.

XXII.

It is unlikely that a nation will be able to maintain, or desire to maintain, an equal balance between its three offensive arms on land, sea and in the air. It must tend to specialize in one, at the expense of the other two. This one must be the air arm. Hence it is not altogether unreasonable to infer that in course of time the land and sea forces as we know them must diminish in importance, until eventually they become the administrative services of the air arm. This is an extreme view. But the possibility of such contingency arising, together with the need for central control, may create a tendency to approximate the organization and administration of all three arms. Should this be the case it will lead to an important development of the three medical services. These three services, existing in three separate watertight compartments, with the same functions, the same methods and the same equipment and personnel, will probably be the first elements to coalesce into one Imperial service.

XXIII.

Other factors may tend to hasten this coalescence and to create a separate medical service not belonging to any one arm but assisting all three, under a separate department of State. The future Geneva Convention, for instance, may demand such a service distinct from the fighting forces. The Red Cross has been abused both intentionally and unintentionally, and nations are not disposed to trust each other in respecting the emblem. They may be prepared to trust each other more if the medical service does not form an integral part of a fighting force but becomes a separate humanitarian organization, inspected, perhaps, by neutral commissioners. Another factor is the possible creation of a State Medical Service in European countries, in which case the medical services of armies and navies would be linked up to the civilian medical service of the country to which they belong.

XXIV.

The Geneva Convention is affected considerably by the development of war. The military functions of a medical service must necessarily tend to modify it. It is possible that the Red Cross in future wars may shelter only the serious cases of sickness and wounds, that only certain recognized "sanctuaries" will be respected. In France during the Great War the Red Cross was a doubtful shelter. One day a hospital might be bombed in error, being near a legitimate target; next day another was bombed with intention, as a reprisal for an enemy hospital having been bombed—probably in error. It was a vicious circle of error and reprisal. The presence of neutral commissioners may be the solution of this important problem.

XXV.

Yet again, on the other hand, the Red Cross may cease to carry immunity from attack. The old code of rules under which war was waged, chivalrous and honourable rules, was torn up during the Great War and may not be re-written. A nation whose existence is threatened will abide by no rules if it can save itself through ignoring them. The term "noncombatant" now includes but a small section of a nation—anyone employed on munitions or in any other method of assisting armed forces, regardless of age or sex, is now apparently "combatant." Chivalry has been swept away by the hideous methods of modern war; frightfulness has taken its place. The bombing of towns, the use of gas, the advent of long range guns and similar methods of warfare will cause large numbers of casualties among civilian populations. The provision of medical aid for stricken populations will form an important part of the medical arrangements of future wars.

XXVI.

Through the haze of speculation which surrounds our future responsibilities and duties, shines one clear light. It signals the importance of

preventing skin affections in a force. Scabies, vermin, and other "dirt" diseases caused in France and Belgium almost half the admissions for sickness. So long as men live in close association to each other, whether in battalions, or in camps, with inadequate washing arrangements, these diseases are inevitable. One objective in future must be to have an army which does not scratch itself. The louse must not be mobilized again. To attain this end an army must be equipped with portable baths, laundries, disinfectors, and mobile depots where these can be used and clean clothing issued. Instead of carrying spare clothing in the pack, the soldier may find it waiting for him on the line of march.

XXVII.

One book in particular gives food for reflection. It is "Diseases of the War," Vol. I. Two impressions are obtained from it. First, the achievements of medical science; second, the great possibilities which lie before that science. Relatively, there has been a large measure of success; actually, the position of medicine in its fight against disease is like that of an army which has effected its landing and has consolidated its position on the shores of a vast unexplored continent. One day, that continent may be subjugated, but not yet awhile. Medical science applied to the problems of war is still in its infancy.

XXVIII.

To recapitulate, medicine now forms an essential and important branch of the complex art or science of twentieth century warfare. To get efficient results the role of the medical officer must be vastly enlarged. He requires facilities for the study of war and he requires administrative training. He must eventually take his place as an important executive officer, charged with responsible administrative duties composed largely of those now carried out by officers in charge of administration. The best brains of an army are frequently side-tracked in its medical service. Under existing conditions armies and navies do not obtain full value from their medical services, and the same applies to the civil community. This cannot last, and the medical profession will eventually take a far more prominent part in modern everyday public life.

With regard to medical responsibilities in future war, it is not yet clear whether armies can take the field organized in the formations of the Great War. It is quite obvious that aerial warfare must revolutionize every branch of an army, and lead to wholesale "scrapping" both of units and of ideas. Medical scrap-heaps may be among the largest, for the developments of modern war lead us towards new types of casualties, of ambulance transport and of medical units. Wounds give place to gas—surgery becomes of lesser importance; the Geneva Convention may "peter" out. And the casualties in an army may be equalled by those in the civil popu-

lation. There may be one imperial medical service for all arms, or the medical services may form part of a greater State medical service. "Hygiene" alone may remain as a part of an army. One point is quite obvious—a medical service cannot remain in its present condition for long. The next great war will bring many changes in its organization and scope.

XXIX.

The medical services of armed forces can assure even greater success in future warfare if they continue mentally active during peace. After a great war, with much diminished forces and much necessary economy, this is the difficulty. For the continued mental activity of a service depends on the type of officer recruit who joins, and he in turn depends on the inducement in "scope" and emoluments which a service has to offer him. I put "scope" first as it is assuredly the more important factor. The good type is difficult to keep, the indifferent difficult to shed. By continued research and continued endeavour to obtain the more efficient application of known medical principles to military and naval conditions, the medical successes of future war can be guaranteed. If war happily keeps away from the civilized world medical preparations are not wasted; though designed for the soldier in war they benefit equally the civilian in peace. Members of medical services are perhaps better placed for research and study of administrative medicine than their civilian confrères. In the past they have had the distinction of making many important medical discoveries. May they continue to do so in future.

XXX.

We are living, or existing, through a period of depression (closely parallel to the post-Waterloo period before the rise of Victorian prosperity) which is ill-suited for original work or original thought. Men's brains are "marking time." Many of the present-day troubles are inevitable in an army and a nation after a long and exhausting war, to the victors only in a lesser degree than to the vanquished. Like individuals and communities, the Royal Army Medical Corps is affected by these conditions. It is acting up to its motto loyally. Let us remember that the foundations of its fame in the Great War were carefully laid during the years of peace before 1914. It was perhaps the keenest branch of a keen pre-war army. Its preparations to deal with the menace of war were remarkably complete; it saw big and thought big. The spirit of such a Corps is not to be broken by a few years of adverse conditions; with renewed keenness it will prepare itself for the widened scope and increased responsibilities which lie before it.

ARMY HYGIENE ADVISORY COMMITTEE REPORT No. 3.

On the Maximum Load to be Carried by the Soldier.

By Professor E. P. CATHCART, F.R.S.
Captain D. T. RICHARDSON, M.C.
Royal Army Medical Corps.
and
Captain W. CAMPBELL
Royal Army Medical Corps.

From the Physiology Institute, University of Glasgow.

(*Continued from p.* 443, *Vol. XL.*)

IV.—Present Investigation.

In the series of experiments now recorded the various tests were carried out on two of the writers of this report, Captains Richardson and Campbell, both of the Royal Army Medical Corps. Both were in excellent physical condition at the start of the experimental work, as they had just finished the full course at the Central Gymnasium, Aldershot. They maintained this fitness throughout. They differed very markedly, both in build and in temperament.

Richardson's mean weight (nude) was 70·3 kilos, his height 174·5 centimetres, giving a surface area of 1·85 square metres. Campbell's mean weight was 67·4 kilos and his height 168 centimetres, giving a surface area of 1·77 square metres.

The marching was, unless otherwise stated, carried out in a large, well-lit, well-ventilated, wood-floored laboratory, which gave a free circuit of 37 metres, i.e., 27 circuits amounted approximately to 1,000 metres.

The method employed to determine the energy expenditure was that of Douglas-Haldane, of which one of us (E. P. C.) has already published a full account. Cathcart and Orr, in their report on the "Energy Expenditure of the Infantry Recruit in Training," had already shown that it served admirably for the determination of the energy expenditure of mobile subjects. We are able to confirm this finding. The analyses were always done in duplicate. Sometimes each analyst did a duplicate analysis of his own sample, thus giving four analyses in all of the same expired air. The majority of the earlier samples were thus analysed, especially in the experiments made for the definite determination of the maximum economic load. The Haldane burettes used were most carefully calibrated and the necessary correction factors determined. Control analyses of atmospheric air were made frequently.

The load carried was the ordinary infantry equipment, less rifle, made

up to the appropriate percentage of the body weight by the addition of weights properly distributed between the pack and the ammunition pouches. Obviously, when the heavier loads were carried the bulk of the weight was placed in the pack.

The great majority of the experiments, all of those recorded in the present report for instance, were not done in the post-absorptive state. They were usually carried out about three hours after a comparatively light meal. In order that a standard value might be obtained for comparison, and for the determination of net values, an estimation of the metabolism of the subject after lying at complete rest for thirty to forty minutes on a bed always preceded the experiment.

A very large number af preliminary experiments, lasting over nearly two months, were carried out, and repeated rough determinations, in various ways, of the maximum load were made, in order to accustom the subjects to the procedure and to ensure that the majority of the more obvious sources of experimental error were eliminated before the series of experiments detailed in this report were begun. The results of these preliminary experiments tallied, on the whole, very well with those now given.

(1) *Varying Load.*

Two types of marching load test were carried out: (*a*) one in which in the course of two marches of long duration loads varying from twenty-five per cent to sixty-five per cent of the body weight were carried in turn. Tests were made either with increasing or decreasing loads. These experiments are represented by Table I (R) with decreasing load and Table II (C) with increasing load. Thus in the experiments recorded in Table I the subject, after the determination of the resting value, commenced marching with a load equal to sixty-five per cent of his body weight. After marching at the set rate for a preliminary period of never less than fifteen minutes. a determination of the energy expenditure was made. The load on the completion of the determination was changed to one sixty per cent of the body weight and the march resumed. On the completion of the 60 per cent test, one at 55 per cent was done, then at 50 per cent and 45 per cent. Next day the series of load marches was completed from forty-five to twenty-five per cent in the same fashion. When increasing loads were tested on this plan the initial march took place with a load of twenty-five per cent of the body weight and was continued in two stages on separate days to sixty-five per cent of the body weight.

(*b*) In the second series of tests a single load was carried for at least one hour, during which time three or four determinations of the energy expenditure were made. The loads tested were from twenty-five per cent to sixty per cent of the body weight, see Tables III and IV.

The experiments have all been summarized in Table V, which will be used for a discussion of the influence of load.

Ventilation in Litres per minute.—It will be noted that the general result shows a slight initial decrease in the ventilation rate, thereafter a steadily increasing ventilation. After 35 per cent the average increase for each 5 per cent load increase is about 1·5 litres, except between 50 per cent and 55 per cent, which is very low, and between 60 per cent and 65 per cent, which is very high.

TABLE I.—RICHARDSON DECREASING LOAD. MARCHING RATE 5,550 METRES PER HOUR.
Average of two or more Analyses. Values are given less basal.

Total weight in kilos	88·12	91·65	95·18	98·2	102·23	105·00	109·28	112·30	116·33
Load in percentage of body weight	25 per cent	30 per cent	35 per cent	40 per cent	45 per cent	50 per cent	55 per cent	60 per cent	65 per cent
Ventilation litres per minute	13·98	14·75	13·23	16·89	17·08	18·00	19·08	20·83	24·15
Oxygen intake per minute in c.c.	789	856	889	887	981	1,061	1,039	1,125	1,187
Total calories cost per minute	3·80	4·12	4·22	4·37	4·76	5·13	5·05	5·53	6·15
Calories per square metre surface per minute	2·05	2·23	2·28	2·36	2·57	2·77	2·73	2·99	3·32
Total weight, grm. calories per kgm.	0·49	0·51	0·50	0·50	0·52	0·55	0·52	0·55	0·60
Grm. calories per kgm. per square metre	0·262	0·273	0·269	0·270	0·283	0·296	0·281	0·299	0·321
Oxygen intake per kgm. in c.c.	0·101	0·105	0·105	0·102	0·108	0·114	0·107	0·113	0·115
Oxygen intake per kgm. per square metre in c.c.	0·055	0·057	0·057	0·055	0·058	0·062	0·058	0·061	0·062

TABLE II.—CAMPBELL. INCREASING LOAD. MARCHING RATE 5,550 METRES PER HOUR.
Average of two or more Analyses. Values are given less basal.

Total weight in kilos	84·71	88·07	91·49	94·85	98·26	101·65	105·04	108·43	111·81
Load in percentage of body weight	25 per cent.	30 per cent.	35 per cent.	40 per cent.	45 per cent.	50 per cent.	55 per cent.	60 per cent.	65 per cent.
Ventilation litres per minute	16·86	15·99	14·54	18·03	19·14	21·80	21·71	25·09	28·89
Oxygen intake in c.c. per minute	970	980	932	1,064	1,085	1,140	1,166	1,245	1,442
Calories cost per minute	4·75	4·73	4·49	5·16	5·28	5·74	5·60	6·11	7·07
Calories cost per square metre per minute	2·68	2·67	2·54	2·91	2·99	3·24	3·17	3·45	3·99
Grm. calories per kgm. (total weight)	0·585	0·555	0·508	0·563	0·557	0·587	0·552	0·585	0·654
Grm. calories per kgm. per square metre (total weight)	0·330	0·313	0·287	0·318	0·314	0·331	0·312	0·330	0·369
Oxygen intake per kgm. in c.c.	0·120	0·115	0·106	0·116	0·114	0·117	0·115	0·119	0·134
Oxygen intake per kgm. per square metre in c.c.	0·068	0·065	0·060	0·066	0·064	0·066	0·065	0·067	0·076

TABLE III.—RICHARDSON: LOAD CARRIED AT LEAST ONE HOUR.
MARCHING RATE 5,550 METRES PER HOUR.

Data given average from duplicate Analyses of from Three to Five Samples collected during the March. Values given are net.

Total weight in kilos	87·7	91·2	95·2	98·7	102·25	105·75	109·28	112·80
Load in percentage of body weight	25 per cent	30 per cent	35 per cent	40 per cent	45 per cent	50 per cent	55 per cent	60 per cent
Ventilation litres per minute	17·96	15·79	17·12	16·92	20·63	19·50	22·32	20·90
Oxygen intake in c.c. per minute	923	888	928	915	1,095	1,114	1,193	1,155
Calories cost per minute	4·59	4·26	4·55	4·49	5·36	5·37	5·89	5·68
Calories per square metre per minute	2·483	2·304	2·461	2·430	2·896	2·903	3·185	3·070
Grm. calories per kgm. (total weight)	0·566	0·510	0·517	0·492	0·556	0·549	0·582	0·543
Grm. calories per kgm. per square metre (total weight)	0·305	0·275	0·279	0·265	0·300	0·296	0·325	0·293
Oxygen intake per kgm. in c.c.	0·113	0·104	0·105	0·100	0·116	0·114	0·118	0·112
Oxygen intake per kgm. per square minute in c.c.	0·061	0·056	0·056	0·054	0·063	0·062	0·064	0.061

TABLE IV.—CAMPBELL: LOAD CARRIED AT LEAST ONE HOUR.
MARCHING RATE 5,550 METRES PER HOUR.

Data given average from duplicate Analyses of from Three to Five Samples collected during March. Values are net.

Total weight in kilos	84·71	88·1	91·65	94·87	97·5	101·65	105·04	108·0
Load in percentage of body weight	25 per cent	30 per cent	35 per cent	40 per cent	45 per cent	50 per cent	55 per cent	60 per cent
Ventilation litres per minute	15·83	16·70	17·23	16·61	19·09	22·55	21·25	25·25
Oxygen intake in c.c. per minute	889	918	953	907	974	1,061	1,171	1,257
Calories cost per minute	4·32	4·47	4·64	4·38	4·76	5·23	5·69	6·18
Calories per square metre per minute	2·443	2·524	2·621	2·383	2·596	2·953	3·214	3·493
Grm. calories per kgm. (total weight)	0·553	0·548	0·547	0·498	0·545	0·556	0·585	0·619
Grm. calories per kgm. per square metre (total weight)	0·312	0·309	0·308	0·281	0·307	0·313	0·330	0·349
Oxygen intake per kgm. in c.c.	0·113	0·113	0·112	0·103	0·108	0·113	0·121	0·126
Oxygen intake per kgm. per square metre in c.c.	0·064	0·064	0·064	0·058	0·061	0·064	0·068	0·071

TABLE V.

Average of Results given in Tables I to IV.

Load in percentage of body weight	25 per cent	30 per cent	35 per cent	40 per cent	45 per cent	50 per cent	55 per cent	60 per cent	65 per cent
Ventilation litres per minute	16·16	15·81	15·53	17·11	18·98	20·46	21·09	23·02	26·52
Oxygen intake in c.c. per minute	893	911	923	943	1,034	1,094	1,143	1,196	1,314
Calories cost per minute	4·367	4·395	4·476	4·599	5·038	5·365	5·559	5·874	6·607
Calories per square metre per minute	2·416	2·431	2·475	2·544	2·762	2·967	3·074	3·251	3·657
Grm. calories per kgm. (total weight)	0·547	0·530	0·518	0·513	0·546	0·560	0·560	0·575	0·624
Grm. calories per kgm. per square metre (total weight)	0·302	0·293	0·286	0·284	0·301	0·309	0·312	0·318	0·345
Grm. calories per metre distance marched per minute	47·21	47·51	48·38	49·72	54·46	58·00	60·10	63·50	71·43
Grm. calories per metre per square metre	26·12	26·28	26·76	27·50	29·86	32·08	33·23	35·15	39·54
Oxygen intake per kgm. in c.c.	0·112	0·109	0·107	0·105	0·112	0·115	0·115	0·118	0·125
Oxygen intake per kgm. per square metre in c.c.	0·062	0·0605	0·0592	0·058	0·0615	0·0635	0·0638	0·065	0·069

Oxygen intake per Minute.—It might have been assumed that the intake of oxygen would be intimately associated with the ventilation, that the same slight fall in the initial weights would have been found and thereafter an increase, but such is not the case. There is a steady rise in the oxygen intake from the lightest to the heaviest load. There is no regularity in the increase in the oxygen intake. A definite rise takes place between 40 per cent and 45 per cent, and a very marked increase between 60 per cent and 65 per cent. If the oxygen intake be utilized to determine the cost per horizontal kilogrammetre as suggested by Liljestrand and Stenström, in this instance at least the result as fig. 1 shows is even more dramatic than the result stated in terms of gramme calories. The oxygen intake pronounces very definitely in favour of the forty per cent load.

Calorie cost per Minute.—In view of the fact that the calorie output per minute is based on the relation existing between the oxygen intake and the respiratory quotient, it is not surprising that the calorie cost bears some resemblance to the oxygen consumption. It will be noted that there is a progressive rise in cost throughout the series. This is very evident whether the total calories or the calories per square metre surface are examined, but it will also be noted that the most sudden jumps in the series take place between 40 per cent and 45 per cent, and then later between 60 per cent and 65 per cent. This sudden alteration in the cost of performance is shown very clearly in fig. 2. The squares between the

various weights are drawn to scale and represent the difference in cost which exists in the carriage of the two loads. The ratio of the cost differences for loads from twenty-five per cent to forty-five per cent of the body weight is approximately:—

25—30 per cent	30—35 per cent	35—40 per cent	40—45 per cent
1	3	4·6	14·6

There is, therefore, very definite evidence that a critical point in the cost of the carriage of loads exists somewhere in the neighbourhood of a

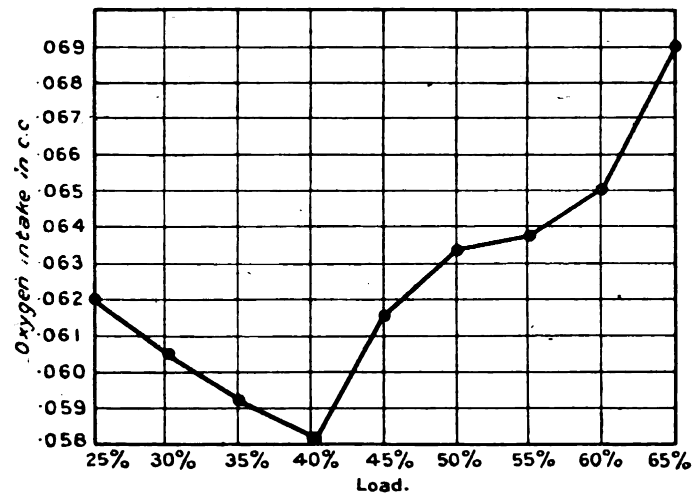


FIG. 1.—Varying Load. Oxygen intake per kgm. per square metre.

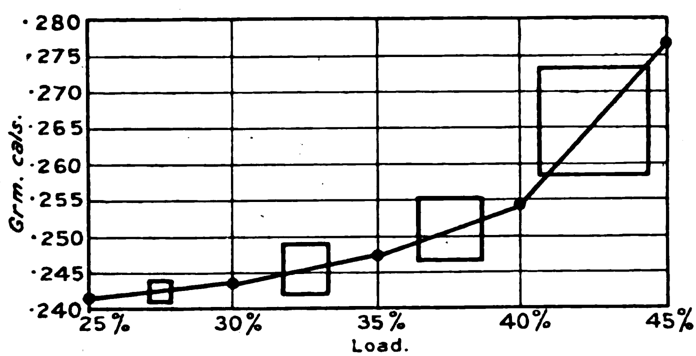


FIG. 2.—Varying Load. Calories per square metre per minute Squares = Difference in cost of carriage between loads.

load equal to forty per cent of the body weight, i.e., if the weight of the average soldier be taken to be (see p. 438, vol. XL.) 135 pounds, the maximum load he can carry and remain efficient is about fifty-four pounds.

When the cost of transport is calculated on the total weight of the man and his load in gramme calories per horizontal kilogrammetre, i.e.,

the cost of forward transportation of the total weight, it will be noted that there is a definite fall in the cost from twenty-five per cent to forty per cent, which is followed by a sudden jump in the cost (see fig. 3).

When the cost in gramme calories per metre distance covered is examined the same marked increase in the cost of forward progression is noted between forty per cent and forty-five per cent of the body weight. Here, too, the ratio of the difference in cost for the various loads from twenty-five per cent to forty-five per cent of the body weight is approximately:—

25—30 per cent	30—35 per cent	35—40 per cent	40—45 per cent
1	3	4	15·5

i.e., even taking simply distance covered there is definite evidence of a critical point at a load of forty per cent of the body weight.

Another point which comes out quite definitely in the summary of the results of these experiments is that it would appear to be somewhat more costly to carry light loads, i.e., below 35 per cent of the body weight,

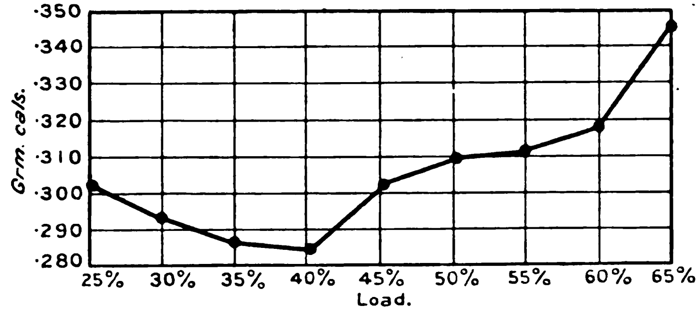


FIG. 3.—Varying Load. Total weight, grm. calories per kgm. per square metre.

than loads of 35 per cent or 40 per cent, indeed it would seem that not only is a load of forty per cent the maximum, but even the optimum load for marching. If we take the cost in gramme calories per horizontal kilogrammetre per square metre of carrying a load forty per cent of the body weight as the basal figure then the differences in cost from the basal for the various loads are as follows:—

25 per cent	30 per cent	35 per cent	40 per cent	45 per cent	50 per cent	55 per cent	60 per cent	65 per cent
18	9	2	0	17	25	28	34	61

That the lighter loads work out more costly may be due in large part to the fact that such loads do not worry the well-trained marcher: he feels so light and free that he indulges in many extraneous movements which play no actual part in the carriage of the load, yet, when summed up, bring about an appreciable rise in the cost. With a load equal to forty per cent of the body weight the subject appreciates this weight and it is sufficiently

heavy to stabilize him and to cause him to husband his energy. Of course it is really a misnomer to refer to such a load as forty per cent of the body weight as being the optimum load, as it is merely optimum in terms of carriage per horizontal kilogrammetre. The real optimum, from an expenditure of energy standpoint, would probably be reached with no load at all.

It will be remembered that in the discussion of the previous work done on the carriage of loads that Brezina and Reichel found that loads below about thirty per cent of the body weight might be regarded as being equivalent to so much body weight.

Laulanié in a series of experiments which he carried out on another type of work, and at rates self-selected by the subject, also found that the most effective rate of work, although self-selected, was not that in which the amount of work done was lowest.

Another point of very considerable interest emerges, namely, that after the definite rise in cost in the carriage of loads between forty per cent and forty-five per cent of the body weight the subsequent differences between the increasing loads tend to become less, in other words more or less of a plateau is reached. There is, however, another very definite rise after a load equal to sixty per cent of the body weight is reached. If we again refer to the 135 pound man a load equal to 65 per cent of this weight would be approximately 88 pounds, and it would manifestly be an intolerable and costly method of transporting the load in question. Yet as already noted (p. 438, vol. XL.) in the late war very often men were asked to try and carry not 65 per cent but 75 per cent, 80 per cent and even greater loads.

(2) *Varying Rate of Marching.*

As the evidence seemed to favour the view that the critical load lay between thirty-five per cent and forty-five per cent of the body weight, a series of tests were carried out on the influence of velocity of marching, carrying loads equal to 35 per cent, 40 per cent and 45 per cent of the body weight. Four velocities were selected, the length of pace being kept constant at the subject's normal, about eighty-three centimetres for Richardson and 80·5 centimetres for Campbell. The rates were per minute: (1) fast 109·7 metres (120 yards); (2) normal 91·44 metres (100 yards); (3) slow 73·15 metres (80 yards); and (4) very slow, 54·9 metres (60 yards). The results of these experiments will be found in Tables VI, VII, VIII. In each experiment, with each load, two samples of expired air were taken (1) after twenty-five minutes marching, and (2) about thirty minutes later. The result given is the mean of the two. Tables VI and VII give the results for the two subjects separately grouped in rates of progression, whereas the summary Table VIII of the two sets of experiments gives the results grouped in loads.

TABLE VI.—MARCHING; VARYING LOAD AND RATE; NORMAL PACE.
RICHARDSON: NORMAL PACE = 83 CM.

Rate per minute metres/yards	Normal: 91·44/100			Fast: 109·7/120			Slow: 73·15/80			Very slow: 54·9/60		
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation litres per minute, net	17·59	18·00	18·72	29·14	30·01	32·00	11·28	10·51	13·01	7·92	9·44	9·26
Oxygen intake in c.c. per minute, net	994	947	1,063	1,571	1,645	1,606	590	576	668	410	473	487
Calorie cost per minute, net	4·797	4·620	5·189	7·753	8·051	7·988	2·840	2·752	3·282	1·974	2·315	2·379
Calories per square metre per minute, net	2·590	2·497	2·806	4·190	4·350	4·331	1·536	1·488	1·777	1·094	1·252	1·286
Grm. calories per kgm. (total weight)	0·55	0·52	0·57	0·75	0·75	0·72	0·42	0·39	0·45	0·39	0·44	0·44
Grm. calories per kgm. per sq. metre	0·297	0·281	0·308	0·405	0·405	0·389	0·227	0·210	0·243	0·210	0·237	0·237
Grm. calories per metre per square metre	28·32	27·30	30·68	38·19	39·65	39·48	20·99	20·34	24·29	18·45	22·15	23·90

TABLE VII.—MARCHING; VARYING LOAD AND RATE; NORMAL PACE.
CAMPBELL: NORMAL PACE = 80·5 CM.

Rate per minute metres/yards	Normal: 91·44/100			Fast: 109·7/120			Slow: 73·15/80			Very slow: 54·9/60		
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation litres per minute, net	15·83	16·30	18·24	31·33	30·45	33·64	10·58	9·75	11·00	7·11	8·39	9·65
Oxygen intake in c.c. per minute, net	925	859	989	1,614	1,606	1,670	542	562	651	328	436	499
Calories cost per minute, net	4·419	4·177	4·720	7·888	7·825	8·233	2·616	2·666	3·118	1·648	2·088	2·370
Calories per square metre per minute, net	2·694	2·359	2·649	4·456	4·421	4·625	1·478	1·506	1·761	0·932	1·180	1·339
Grm. calories per kgm.	0·53	0·49	0·53	0·79	0·77	0·78	0·40	0·39	0·44	0·33	0·40	0·44
Grm. calories per kgm. per sq. metre	0·299	0·276	0·299	0·446	0·435	0·440	0·225	0·220	0·248	0·186	0·225	2·48
Grm. calories per metre per square metre	29·46	25·79	28·96	40·61	40·40	42·16	20·20	20·58	24·07	16·97	21·49	24·38

If Table VI (Richardson) be considered first it will be noted as regards the ventilation that, with the exception of the slow rate, there is a definite rise with each increase of load, but the difference between the 40 per cent and 45 per cent load is greater than that between 35 per cent and 40 per cent except at the very slow rate. In the case of the slow rate the ventilation with the 40 per cent load is the lowest. In the case of Campbell, Table VII the ventilation is throughout definitely in favour of the 40 per cent load.

When the oxygen intake of Richardson is considered it will be noted that at the normal and slow rates the oxygen intake is lowest with the 40 per cent load, at the fast rate with this load it is curiously enough highest

(both sets of double analyses agreed very well) and at the very slow rate the 35 per cent load is definitely the lowest. With Campbell at the fast and normal rates the intake was lowest with the 40 per cent load and at the slow and very slow rates, more particularly the latter, it was lowest with the 35 per cent load.

Naturally the calorie cost follows fairly closely the oxygen intake

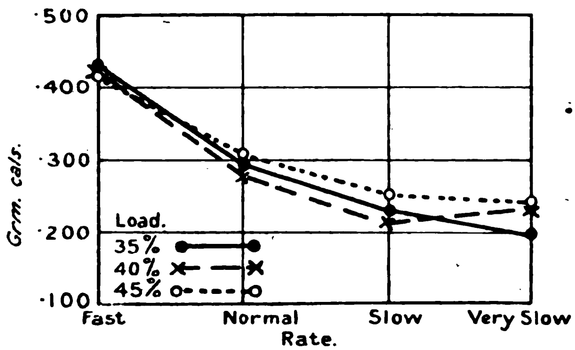


Fig. 4.—Varying Rate. Grs. calories per kgm. per square metre.

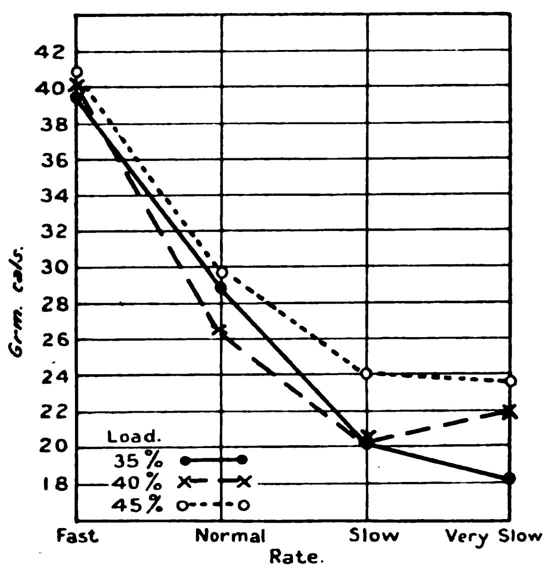


Fig. 5.—Varying Rate. Grm. calories per metre per square metre.

figures. When the cost in gramme calories per horizontal kilogrammetre is examined it is noted with Richardson, Table VI, that at the normal and slow rates the results are definitely in favour of the 40 per cent load, whereas at the fast rate the value favours the 45 per cent load. It is possible that the heavier load with the increased pace cuts out many

of the extraneous movements which usually develop when the pace is unnaturally increased. The lowest value at the very slow rate of progression is with 35 per cent. When the cost in gramme calories per metre is considered a very similar relation is found, except that at the fast rate the value for the load of 35 per cent is definitely lower than the almost equal values for the 40 per cent and 45 per cent loads. In the experiments on Campbell it is found that, with the exception of the very slow rate of marching, the cost in gramme calories per horizontal kilogrammetre is in favour of the 40 per cent load, whereas when the cost per metre is considered the values reach a minimum with the 40 per cent load with fast

TABLE VIII.—MARCHING; VARYING RATE AND LOAD; NORMAL PACE. SUMMARY.

Load	35 per cent.				40 per cent.				45 per cent.			
Rate	Fast	Normal	Slow	Very slow	Fast	Normal	Slow	Very slow	Fast	Normal	Slow	Very slow
Richardson—												
Ventilation litres per minute	29·14	17·59	11·28	7·92	30·01	18·00	10·51	9·44	32·00	18·72	13·01	9·26
Oxygen in c.c. per minute	1,571	994	590	410	1,645	947	576	473	1,606	1,063	668	487
Calories per hour	465·18	487·8	170·4	118·4	483·1	277·2	165·1	138·9	479·3	311·3	196·9	142·7
Calories per sq. metre per hour	251·4	155·4	92·2	65·6	261·0	149·8	89·3	75·1	259·9	168·4	106·6	77·2
Grm. calories per kgm.	0·75	0·55	0·42	0·39	0·75	0·52	0·39	0·44	0·72	0·57	0·45	0·44
Campbell—												
Ventilation ..	31·33	15·83	10·58	7·11	30·45	16·30	9·75	8·39	33·64	18·24	11·00	9·65
Oxygen in c.c. per minute	1,614	925	542	328	1,606	859	562	436	1,670	989	651	499
Calories per hour	473·3	265·1	156·9	98·9	469·5	250·6	160·0	125·3	494·0	283·2	187·1	142·2
Calories per sq. metre per hour	267·4	161·6	88·7	55·9	265·3	141·5	90·4	70·8	277·5	158·9	105·7	80·3
Grm. calories per kgm.	0·79	0·53	0·40	0·33	0·77	0·49	0·39	0·40	0·78	0·53	0·44	0·44
Average R. and C.—												
Calories per sq. metre per hour	259·4	158·5	90·4	60·8	263·1	145·7	89·8	73·0	268·7	163·7	106·1	78·8
Grm. calories per kgm.	0·77	0·54	0·41	0·36	0·76	0·51	0·39	0·42	0·75	0·55	0·45	0·44
Grm. calories per metre per sq. metre	39·40	28·89	20·59	18·45	40·03	26·55	20·46	22·15	40·82	29·82	24·18	23·90

Grm. calories per horizontal kgm., mean for *all* loads F. 0·76 N. 0·53 S. 0·42 V.S. 0·41.

and normal rates of marching, and with the 35 per cent load at the slow and very slow rates. (See figs. 4 and 5.)

When these results are considered under the different loads in relation to the rate of marching as in Table VIII it will be noted that as regards ventilation with each load in both subjects the maximum is reached with the fast rate of marching, i.e. the ventilation definitely increases with the rate. In each load with Richardson the difference in ventilation rate between the very slow and slow march is small, 3·36 litres per minute with the 35 per cent load, 1·07 litres with the 40 per cent, and 3·75 litres with 45 per cent. The difference between slow and normal is somewhat greater,

amounting to 6·31 litres per minute with the 35 per cent load, 7·49 litres with 40 per cent, and 5·71 litres with 45 per cent, but the difference between normal and fast is very marked with all three loads, 11·55 litres with 35 per cent, 12·01 litres with 40 per cent, and 13·28 litres with 45 per cent. With Campbell the values are for the 35 per cent load 3·47 5·25 and 15·50 litres per minute; for the 40 per cent load 1·56, 6·55, and 14·15 litres per minute, and for the 45 per cent load 1·35, 7·24, and 15·40 litres per minute.

In the case of the oxygen intake there is again the same type of variation; the mean difference for both subjects is as follows:—

OXYGEN DIFFERENCE IN CUBIC CENTIMETRES.

Rate metres per minute		35 per cent	40 per cent	45 per cent
54·9 —73·15	V.S.—S.	197	115	167
73·15—91·44	S.—N.	394	335	367
91·44—109·7	N.—F.	633	723	612

The increase in the rate of marching is approximately 18·25 metres per

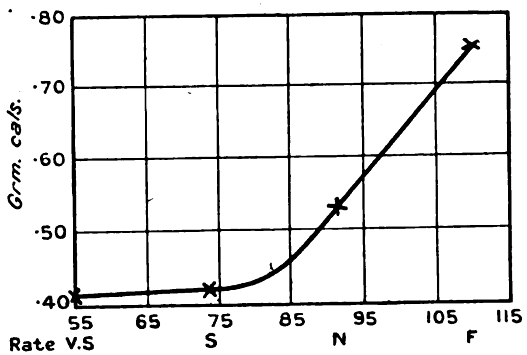


FIG. 6.—Average Cost in grm. calories per kgm. Different Rates of Marching.

minute. These oxygen differences increase at a different ratio to that of the marching rate, as the following table shows:—

Ratio	Very Slow—Slow	Slow—Normal	Normal—Fast
Of marching velocity increase	1	1	1
Of increased oxygen intake 35 per cent load (approx.)	1	2	3
Ditto 40 per cent load	1	3	6
Ditto 45 per cent load	1	2	4

It is evident then that as the rate of marching increases the cost rises rapidly and that this increase in cost is greater proportionately than the increase of rate. That this is so is also rendered manifest from the consideration of the cost in gramme calories per horizontal kilogrammetre (see Table VIII). If the average of the cost in gramme calories of the transport of the total weight, irrespective of the particular load, per horizontal kilogrammetre, be taken it is found to be as follows:—

	Rate in metres per minute			
	54·9	73·15	91·43	109·7
Cost in gramme calories per kgm.	0·41	0·42	0·53	0·76

These figures graphed are shown in fig. 6. It is evident that they

support the contention of Durig, Brezina and his co-workers, also of Cathcart, Lothian and Greenwood, that the maximum economic rate of marching lies in the neighbourhood of eighty metres per minute. The figures certainly do not support in any way the contention of Zuntz and Schumburg that the cost of moving unit mass through unit distance increases directly with the velocity of movement. The data giving the cost per metre in gramme calories per square metre shows very definitely that the cost does not remain constant for all rates, that, on the contrary,

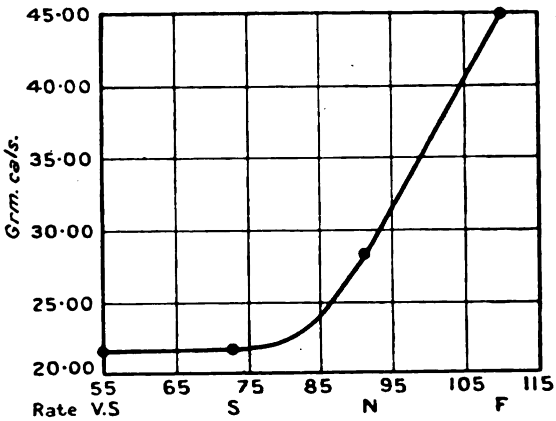


Fig 7.—Cost in grm. calories per metre. Varying Marching Rates.

when the velocity exceeds the economic maximum the cost per metre definitely rises. The mean cost per metre, irrespective of the load carried, is (see also fig. 7) as follows:—

	Rate of marching metres per minute			
	54·9	73·15	91·43	109·7
Cost in gramme calories per metre	21·50	21·74	28·42	40·06

Except in the case of the very slow rate of marching the influence of the load on the cost is not so marked as might have been expected.

(*To be continued.*)

HABITS, CUSTOMS AND MODES OF LIFE OF THE NATIVE TRIBES OF BRITISH EAST AFRICA (NOW KENYA COLONY).

By Captain R. L. STANLEY, M.B.E.

(*Continued from p.* 453, *Vol. XL.*)

The Akamba.

The Akamba and sub-tribes, including the Aithangu, Atangwa, Atei, Asi, Akitondo, Amuyi, Akitutu, Aombe, Atui, Amonda, Amoi and Ameombe, occupy the districts of Machakos and Kitui and surrounding areas.

The data given here may be said to apply to the Akamba generally, but certain minor variations exist in the modes of building, birth and funeral ceremonies, etc., among the different sub-tribes. For example, some use a central pole as a support to their huts, some slaughter oxen and indulge in feasts during birth ceremonies, and so on, while others do not.

The Akamba live in small hamlets or villages which are composed of beehive-shaped huts, with or without a central pole, built with a framework of sticks and thatched with grass, the latter extending to the ground level. In all building operations the men cut the wood or sticks and the women gather the grass and do the thatching. The villages are not fenced in, and the huts are arranged in rows, about twenty yards apart, each row consisting of from two to eight huts. These are occupied by the members of one family, the head of the family, as the numbers of his wives and children increase, adding new huts in line with his own. Each hut is about twelve feet in height, eight feet in diameter, has a single low entrance about three feet in height, which is the only means of ventilation and light, and is situated at a distance of some eight yards from the next. The huts are all built on rising ground, the cattle kraal and a form of combined latrine and rubbish heap being placed at consecutively lower levels. The cattle kraal is a circular zareba of thorns and brushwood and is unprotected above. When the kraal gets into an insanitary condition, due to the accumulation of excreta, the thorn fence is opened at its lowest level, a shallow drain dug leading to the latrine area, and the kraal cleansed through this channel. The latrine is merely an uncleared area with a diameter of about fifteen yards in which the people defecate promiscuously anywhere, the grass and shrub affording the required privacy. This area is surrounded by a semi-circular thorn fence and the gap in the fence faces towards the kraal.

Goats, sheep and fowls are accommodated in the huts with the natives, the fowls having a small area caged off with sticks and twigs.

Groundnuts, bananas, beans, maize, sweet potatoes, sugar cane and other foodstuffs are grown and meat is extensively eaten. The sexes eat

separately, the women and children in their huts and the men outside. There are some animal foods which certain of the sub-tribes are prohibited from eating, one example being liver. Fish, lions, leopards, snakes, crocodiles and hyenas are apparently not eaten by the Akamba. The incisor teeth of the tribe are filed to a point the more readily to enable them to tear meat, cooked or uncooked, when eaten.

Dependents and poor strangers are sometimes maintained for life, and in many instances these are slaves taken in inter-tribal warfare.

Foodstores are situated outside the huts, to which they are similar in structure, but smaller and raised on stakes. Their under surfaces are composed of crossed sticks and plastered below with a mixture of cow-dung

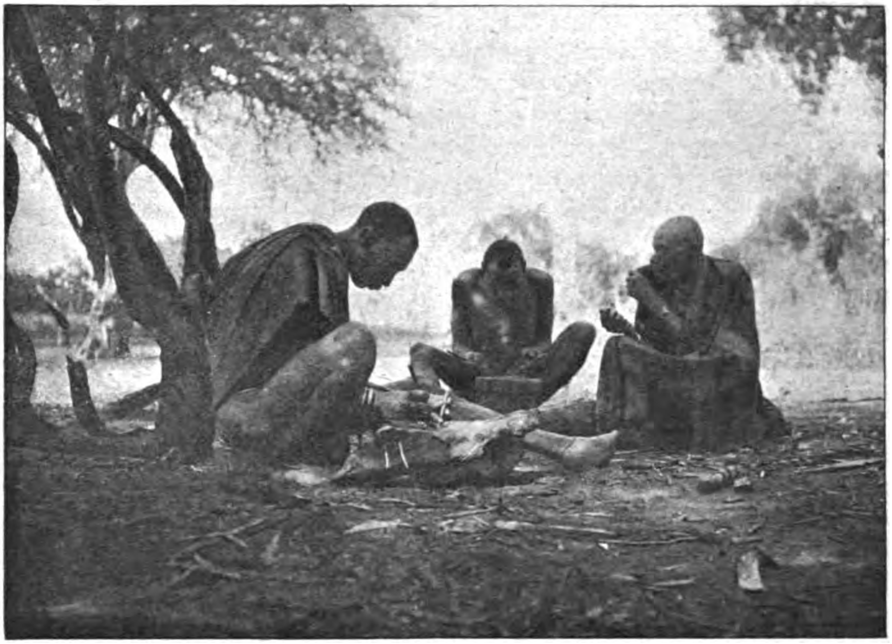


FIG. 3.—Akamba Smiths.

and red earth which is said to act as a repellent to rats. These granaries are some eight feet in height by eight feet in diameter.

Intoxicants are made from honey, sugar-cane, mtama meal and the palm. They form part of the presents given in a marriage dowry, are used at all meetings of elders, and given as fees before the judicial councils, besides being largely drunk at birth, funeral and circumcision festivals.

All manner of illnesses prevail among the tribe and but little precaution is taken. Smallpox contacts kill a sheep, take the stomach contents and plaster their bodies with it, and stay in this condition for a day and night, during which they eat the flesh of the slaughtered sheep. They bathe their bodies the following morning.

Medicine men are prominent among the Akamba and may or may not be subservient to the chiefs. They practise witchcraft, and some are apparently expert hypnotists. They take part in all ceremonies which are in any way connected with their craft. The tribe believes in a deity, has sacred groves and oracles which are under the influence of the medicine men who make oracular announcements. Libations of wine and milk and sacrifices of black goats are offered at these places. The ordinary medicine man who prescribes for sickness has not much influence, but he who is a seer or prophet has considerable influence and is respected by the chiefs without exercising any control over them or being much controlled by them. So far as is known they do not teach any system of theology.

Many medicinal decoctions are made from the leaves, stems and barks of plants and used as cathartics, astringents, etc. For febrile ailments the following procedure is adopted:—

The bark and the roots of two plants called *kidungu* and *wala* are ground together, a pint of water added and the whole boiled. The fluid is drained off and a fowl's blood mixed with it. One cupful of this mixture is taken morning and evening. If the sick person is not better the next day a sheep that has not borne young is forcibly caught by the neck, which is said to immediately induce micturition, its urine being caught in a bowl. A young unmarried girl is made to micturate into the same vessel and the mixture of the two urines is given to the patient to drink. If the patient improves under this treatment in twenty-four hours he is fed on mutton. If still sick, the whole of a small shrub called *kiunyokwe*, which grows spreading along the ground, is crushed, boiled in a pint of water, and a cupful of this fluid and the squeezed-out juice is drunk, and the patient fed on a fowl. Should there then be no improvement the mganga is called in to decide whether the fever is due to natural causes or to witchcraft, and administers further treatment accordingly.

A treatment, amongst others, for intestinal worms is to strike off the head of a fowl, when the patient drinks the whole of the blood obtainable by sucking at the severed part.

The dead are either disposed of by burial in the thorn boma (cattle kraal) or thrown into the bush to be eaten by hyenas. Elders and men of consequence are generally buried. Certain ceremonies take place at births and only elders of a certain grade can bury the dead or handle a body.

Deformed children are reared because they are "God's own," with the idea that if a deformed child were put to death, God would take revenge by destroying other members of the family.

Ideas of an after-existence are very vague. There is a belief that the "Aimu" or spirits of the departed have the power to cause evil to the living relatives and bring sickness or misfortune to them. Neglect to remember the spirits at feasts by throwing on the ground a portion of food and drink on festive occasions incurs the displeasure of departed spirits.

When a Mukamba dies the people of the village abstain from copulation.

The relations summon the local elders, who produce a concoction made of the juice of two kinds of trees, which is sprinkled on the floor of the hut and the bed of the deceased. The next-of-kin then copulate, the other party being chosen by a system rather too complicated to describe. It is important that all grown-up members of the village should be present, as if anyone is absent the ceremony has to be repeated again in a modified form on his return. The ceremony appears to be an outward sign of a spiritual purification and is considered to be a safeguard against the curse of the deity in the form of venereal disease.

During parturition the woman assumes the erect posture and grasps two posts fixed in the ground, one on each side of her. Three women attend: one stands at the back and forces the small of the back forward, another sits at the back and keeps the legs separated, whilst the third, an old woman, kneels with a cloth between the patient's extended legs ready to receive the child. If the mother has anyone with whom to leave the baby she returns to work about three days after the birth.

No exact idea can be ascertained of the birth-rate, infantile mortality, or proportion of males to females. Abortion methods are known and sometimes practised. A mixture of cream and red earth is eaten by the woman, after which she swallows a preparation made from a plant called *keliambeti*. The leaves and stems are carbonized in a vessel and the remains powdered. This method is said to induce and complete abortion in three hours. Death during childbirth is not remarkable for its frequency. The period of suckling sometimes extends to two years. Artificial feeding with cow's milk is sometimes adopted, the milk being sucked from a gourd through a succulent tubular vegetable shoot.

THE WA-KIKUYU.

This tribe, with its neighbouring Embu, Emberre, Chuka and Wimbe sections, has probably a bigger population than any other in East Africa and is the source from which most of the labour in the Colony is recruited. The tribe enters into practically every department of the farm, factory. railway and household work, and may be found in varying numbers from the Coast to Victoria Nyanza and even in Uganda. Large tracts of the highlands in the Ukamba and Kenya provinces are peopled by Wa-Kikuyu, but it is difficult to estimate the population of the tribe. The "Kuke," as he is appreciatively called, is on the whole an adaptable and industrious individual.

In his native haunts and natural mode of life he is certainly one of the most primitive examples of man.

The members of the tribe live in circular huts built of small wooden poles, branches of trees and mud walls, the roof being thatched with grass. The height of the walls is usually 4 feet, and the inside of the hut is generally plastered with mud or cow dung. The doorway, which is the only means of ingress and egress, is about 4 feet by 3 feet. There are no

windows, holes, or other means of ventilation beyond the door, which is always closed at night time. The huts are not lighted except by a fire, which is placed in the middle of the hut in the evening, filling the interior with smoke to the discomfort of the occupants, its only means of escape being through the thatched roof. The villages composed of these huts are built round a central open space, the living huts occupying one arc of the circle and the grain and food stores the other. The doors of all huts face inwards towards the centre.

There are no sanitary arrangements, all persons indiscriminately

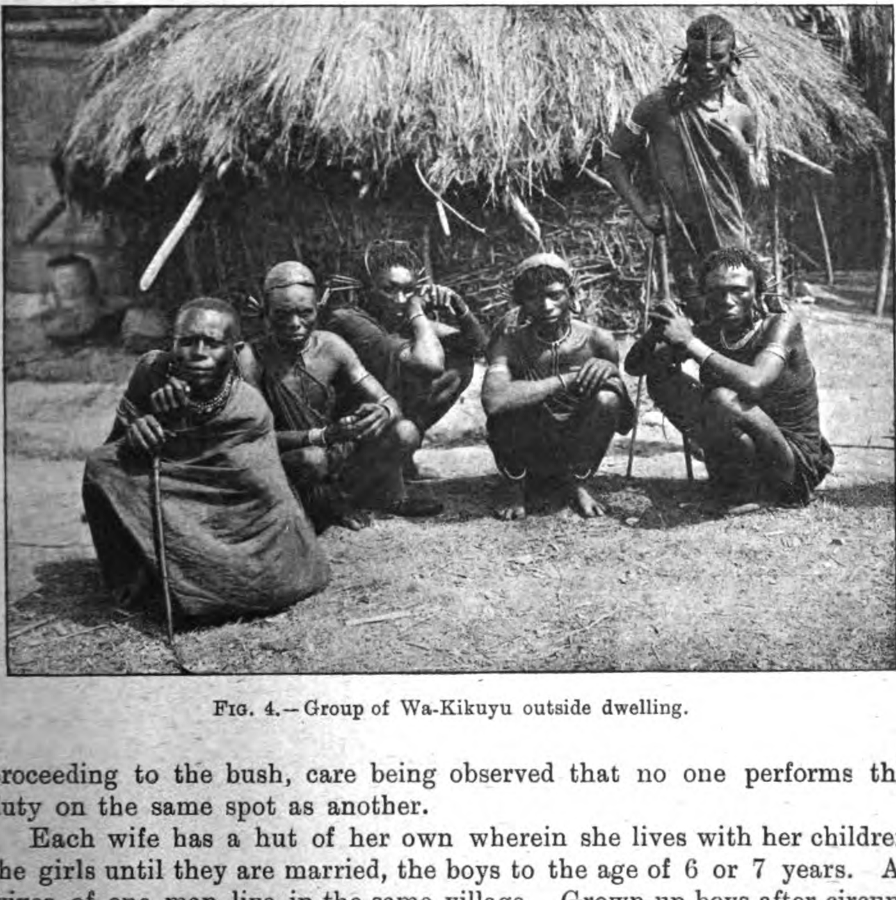


FIG. 4.—Group of Wa-Kikuyu outside dwelling.

proceeding to the bush, care being observed that no one performs this duty on the same spot as another.

Each wife has a hut of her own wherein she lives with her children, the girls until they are married, the boys to the age of 6 or 7 years. All wives of one man live in the same village. Grown-up boys after circumcision and young unmarried men live in special huts.

Dependents are maintained, but are not numerous, and may be unrelated. There is a class of males, poor men, to whom are apportioned widowed women, without dowry or payment. No woman can be married twice. Children are claimed by the relatives of deceased father.

Food is stored in circular wicker huts roofed with grass and raised

from 6 to 12 inches from the ground. Sweet potatoes, yams, mealies and mtama grain are the principally stored articles of food, earthen pots and calabashes being used for storing the grain. Poultry were not kept at one time by the tribe, who believed that the crowing of the cocks led the Masai, their old-time enemies, to their villages. Tribal warfare being now practically a thing of the past, poultry are kept, and with goats, sheep and calves are housed at night with the people in the huts; cattle are stalled in a byre close to the village.

The attitude of the tribe towards disease is indifferent, no precaution being taken except in the case of smallpox, when the afflicted person is quarantined in a hut. No one goes near except the person in attendance and who is one who has previously suffered from the disease.

There are many "medicine men," and their influence is great, though declining. They have practically no real medicines, but carry on their "profession" through trickery, witchcraft and sorcery, by which means they have great influence in the tribe, and are feared by all from the chiefs downwards; indeed, the latter have no control over them. There is no theological system, but reliance is placed on witchcraft and the fear of evil spirits. Their religion is almost entirely animistic, and the main concern is to propitiate the spirits of their ancestors against the evil which they are alleged to bring. The good God to whom they pray is asked for rain or sunshine, help to conquer their enemies in war, and to increase their flocks and herds, but this good God is a very shadowy person as compared with the multitude of evil spirits who are ever trying to do harm.

Another influential class are the prophets, with whom the gift of second sight is not very uncommon. The leading elders approximate to the priest and kill sacrificial goats; each paterfamilias is in a sense the priest of his family.

Of the bad classes there are the cursers and the wizards.

Wives are purchased from their parents for a number of goats and sheep, and the more wives a man has the wealthier he is, and the more hands available to till the soil, which is mainly done by women-folk.

The dying and deceased members of the tribe are invariably put out in the bush where the hyenas eat them. If a dying person is left in a hut, it is abandoned and hyenas enter and drag out and eat the corpse. To touch a dead body is to become unclean. On rare occasions an elder who is held in great respect is buried under a few inches of earth, and the arrangements are carried out by the other elders in a simple way.

A sheep and a goat are killed, the skins of which are used as a shroud, or rather the body lies on one and is covered by the other, and the meat of the slain animals is eaten by the elders.

The grave is not subsequently cared for by anyone, as people will not go near it after burial.

The spirit (Ngoma) of the dead is supposed to hang round the village and is frequently appeased by offerings. When it appears it is generally

malicious, so much so that it will enter goats and cause them to die. The spirits of the dead are believed to live on the snow of Mount Kenya by some sections, and by others to enter the ground where the persons die. The belief in spirits is, however, general, and women will often scream when they say a spirit is near. Some have been heard to express the opinion that humans become animals after death.

Deformed children are, as a rule, killed at birth, but a person who later on becomes so, as also those of weak intellect, are looked after; children born feet first or without hair are also killed, and the usual method adopted is to smother them by filling the mouth with leaves. If twins are the result of a first confinement they are both killed.

The usual length of life of the men and women is 50 to 55 years, although here and there one may reach the age of 80 years. They age early owing to their immoderate drinking of native-brewed beer which is usually made from sugar-cane or honey, or from sugar and maize meal.

The clothing worn consists of a loin cloth hung from the shoulder and made of the dried skin of a goat or sheep. Men and women smear their bodies with a mixture of oil (expressed from the castor-oil plant) and red earth and present a hideous appearance.

The circumcision festival is one of great rejoicing, and takes place when children arrive at the age of 12 years. On these occasions the bodies of males and females, young and old, are smeared with oil, and coloured, and otherwise made to look amazingly gruesome. They are bedecked with feathers, manes of lions, skins, etc.

Tembo (native drink) made from sugar cane, is largely imbibed, and wild shrieks to accompanying dances rend the moonlit air.

The cultivation of the soil and the rearing of cattle, sheep and goats comprise the general work and interest of the Wa-Kikuyu. Many who have come under industrial training have shown skill in various trades and callings, and missions have succeeded in imparting a fair standard of education in many instances.

The Wa-Kikuyu appear to be fairly fertile notwithstanding a high infant death-rate. Children are nursed up to the next pregnancy, and artificial feeding when carried out is with bananas and sheep's fat; should the mother die about childbirth and the child survive, it is usually exposed with the mother and dies unless a wet nurse is available to take it over immediately.

The Masai.

The Masai tribe with its many clans is a more or less nomadic people chiefly engaged, when not raiding their neighbours, in the rearing of flocks and herds and in agricultural pursuits. Cattle are very much prized and loved, and each cow is known by a name. Grass is also loved because the cattle feed on it. In times of drought the women fasten grass to their clothing and offer up prayers for rain. In the past this tribe was very warlike and ever waging war, more particularly on the Wa-Kikuyu. As a result of

British peaceful penetration into Darkest Africa this tribe has more reason to be thankful for the protection now afforded it against such raids than any other. The Masai have a strongly Semitic type of countenance, and with practically nothing of the negro in appearance excepting colour. The young unmarried men are warriors and live in a separate kraal with their mothers and sweethearts, and as a rule marry when about 30 years of age, after which they are exempt from service as warriors. Should a woman

FIG. 5.—Human Pyramid of Masai.

conceive by a warrior he marries her, and should a warrior love a woman much he purposely seduces her so as to take her as a wife. It is, however, considered wrong for unmarried women to have children, and a woman so accused will weep bitterly. There is no limit to the number of wives which a man may have, and rich men who have large herds of cattle may have as many as ten or twenty. When Masai girls wish to marry

they are circumcised. Boys are usually circumcised any time between the ages of 13 and 17.

The Masai usually build a circular kraal, the huts themselves forming the outer wall with the door of each hut facing the centre wherein the cattle and sheep are placed at night. In the event of a lion or other wild animal getting into the kraal, it can be attacked with spears from all sides whilst the spearmen can retire within their huts and carry on this warfare in comparative safety; the destruction of the marauder in this way is practically assured.

The manyatta, or circular kraal of huts, is built of sticks plastered with cow-dung and mud, and each dwelling might be described as resembling an inverted basket. The kraal is not necessarily limited to one family, but each family has its separate entrance. Each wife has a separate hut, the senior wife being placed on the right-hand side of the entrance, the second wife on the left-hand side, the third wife on the left of the second wife, and so on. The small children live with the mother, and uncircumcised youths live in the same huts as their mother but in separate compartments. The low doors of the huts constitute the only means of light and ventilation. The Masai do not keep poultry; calves and lambs are housed in the dwelling huts. There are no latrine arrangements, the bush being resorted to. The manure of the cattle is used for plastering and repairing the huts. The clothing worn by the tribe is of the most scant description and made of skins, or a cheap blanket, or a piece of cotton cloth is suspended from the shoulder to cover the loins. The ears are pierced when young and pieces of wood, metal or wire of varying sizes suspended from the lobes, sides or tops. The bodies are frequently anointed with oil and earth, and occasionally camouflaged in zebra fashion; the smell emanating is none too pleasant.

Until recently only flesh, bullocks' blood and milk were eaten, but fruit, mealie meal and cereals are now partaken of as well. Milk is the chief food amongst the old men, women and children. Meat is roasted on a stick over the fire and soup is made from bones and the bark of the mimosa. Men, women and children all feed in separate groups. Birds, fish, and the flesh of wild animals are not eaten. Venison is eaten by those who have few cattle.

Ablutions are as a rule not performed, and the moran (warriors) are forbidden to use water even for washing faces.

In common with all tribes, the Masai make intoxicating liquors in the usual native manner of fermenting roasted and dried maize. They also brew from honey and the bark of the *il-tarobo* and *sogura* trees. In the case of old men, native beer is considered in some degree as forming part of the food. Drink enters largely into the observance of all ceremonies such as births, dedication of children, marriages, funerals, circumcisions, etc.

The medicine men are called "laibon" and exercise a good deal of influence. Every man has his own "laibon" to whom he goes for any

particular medicine he requires. Of medicines there is an abundant variety, and for all common ailments. They are made from roots, berries, leaves, barks, etc., and by various processes. The Masai as a race has degenerated chiefly owing to the introduction and spread of venereal disease, and morality is not a characteristic feature of their lives.

The witch doctor is more powerful than the physician, and a certain class of "diviner" claims to be able to commune with an all-powerful deity in trance, dream, etc.

There is a general hazy belief in some supreme deity confused with deified natural phenomena, as the Red and Black god of certain clans, the Black god being regarded as benevolent in manifesting itself in cold, mist, rain, etc., and the Red god being malevolent, manifesting itself in the glow of the rising and setting sun and being identified with heat, thunder and lightning.

There are myths connected with the sun, moon, stars and earth. The sky and the earth are gods, the former being the male and the latter the female, as the sky fertilizes the earth. Night is a man and day is a woman because a man is strong and goes out to fight at any time, while the woman stays at home and only works by day.

When the father of a family dies he is mourned by his widows and children. The women and daughters lay aside their iron ear-rings, necklaces, chains, beads, armlets and anklets, and his sons shave their heads. The widows and girls do not put on their ornaments again for a year. If any other relative dies the members of the family go into mourning for one month.

The Masai dispose of their dead by placing them some distance in the bush away from the kraal, when they are later eaten by hyenas. Laibons, chiefs, rich men and very old men are, however, afforded a form of burial by being placed in a shady place in shallow graves. Piles of stones are put over their bodies. For such a sheep is killed, and the dead body, before burial, is anointed with the fat; an ox is slaughtered and consumed on the spot, the bones being left to attract hyenas. The souls of all great men are supposed to take to themselves the form of a snake which would be found in the grave if the stones were disturbed. A place frequented by snakes is always chosen for the grave, so that if it were disturbed a snake would in all probability be discovered. The attitude of the dead as embodied in snakes is benevolent. It is the custom for all passers to place a stone on the grave, it being a place of pilgrimage whereat to solicit favours and assistance.

The spirits of the short-lived and unsuccessful are regarded as malicious, evil and unlucky, and as having departed life with a grievance.

Superstition prevents a dead person's name being mentioned except at the naming ceremony of a child for fear of causing the spirit any offence. In sickness it is often conceived that a deceased parent is endeavouring to get the patient to join him or her in the abode of spirits.

The Masai believe in reincarnation and ancestors being reborn as infants.

The names of successful ancestors (from a native point of view) are repeated before an infant, when the child indicates the particular ancestor re-born by some sign, such as sneezing at the mention of a name, it being prompted at the right moment with a little snuff held to its nose by the individual conducting the ceremony.

The birth-rate is very low and mortality amongst the newly-born is high. When a child is born a bullock is slaughtered and the fat is given to the mother. Women in pregnancy are not well fed and are usually given lean scraps of meat or bones, and milk to which water has been added. There is a custom of extracting the two middle incisor teeth of the lower jaw of children when nearly a year old and again when twelve years old after which the incisors do not grow again. After extraction of teeth donkey's dung is rubbed on the face to cool it. The proportion of males to females is about equal. It has not been ascertained that measures for producing abortion are in vogue, but on the contrary the Masai are very anxious to have as many children as possible. Children are usually breast-fed for a year. Cow's milk is given by the hand in artificial feeding and bullock's fat rubbed on the lips.

The Nandi.

The Nandi, like the Masai, are a warlike and marauding people, but their raiding propensities have been very much curbed by the onward march of civilization and European settlement. They are as brave as but a more robust people than the Masai, whose customs and ceremonies they largely practise.

The dwelling huts are circular and built of sticks and mud, roofed with grass and reeds from swamps, and are located in hidden places by streams and in heavy bush. There is no ventilation except by the small opening which serves as an entrance and, aided by a fire in the centre of the hut, provides for the lighting of the interior. A small hurdle made to fit the opening to the hut operates as a door. Villages, properly speaking, do not exist, clusters of from two to five huts being the rule. These are generally occupied by the members of one family, consisting of the head, his wives and children, and perhaps a married son. Each wife has a separate hut which she shares with her children under 10 years of age. Boys and girls over 10 years live in a hut together until married. Cattle are housed in a kraal situated some distance from the dwellings, and several heads of families may arrange to keep their cattle together. The hut occupied by the grown-up sons and daughters is attached to the cattle kraal. Sheep, goats and poultry are housed in the wives' huts, the goats being tied up at night but not the sheep. There is no space allotted for sheep and goats in the warrior huts of the Nandi tribe and its branches, as all the accommodation is required for the young warriors and their sweethearts.

The "staff of life" among the Nandi is wimbe (a small cereal).

They also cultivate matama (cereal), sweet potatoes, beans and maize. The one regular meal of the day is at 6 p.m., when all the members of the family gather together. Any food left overnight is eaten in the morning before setting off to work. When food is cooked it is dumped out on a skin, and the lady of the house proceeds to divide it up between the members of the family, the head of whom gets his own portion; the grown-up boys and girls eat by themselves in separate groups, and the smaller children together, the mistress finally helping herself to what is left.

Food is stored in a separate hut and is not threshed until required. Rats are a great nuisance in these huts, but they and the mole are eaten

Fig. 6.—Nandi Belles.

in time of scarcity. The uncleansed goat-skin "plate" provides titbit delicacies which attract the rats.

Wimbe beer is made by first crushing and wetting the wimbe, which is then wrapped in leaves and placed in the ground; later it is taken out and dried by the fire, and afterwards put in the sun to complete the drying. It is then placed in a *calabash* or an earthen jar and water added. Other wimbe which has been made to sprout is dried, ground and added. The mixture is left three days, when it is ready for drinking.

Asali tembo (beer) is made by placing honey with grubs and wax mixed together in a jar which is then filled with water. The pods of the

kibuyu tree are added. The resulting intoxicant is ready for drinking on the fourth day.

These drinks are used at marriage and funeral ceremonies. After a good harvest every elder gives a beer drink, to which he invites his neighbours, who, in turn, invite him.

The medicine men are doctors and wizards and carefully guard their secrets. It is unfortunately believed throughout the tribe that the cure for syphilis is to infect another person. A husband will reject his wife if he knows she is infected, but if infected himself will not conceal the fact from his wife. Specifics exist for many diseases and are chiefly obtained from barks and roots. Medicines are disguised before being administered, so that the secret, which is passed from father to son, may be kept.

The wizards are consulted in matters affecting the tribe as a whole, or sections of it, in such matters as pestilence, famine, cattle sickness, or prospects of a war or raid. They act by spells, incantations and charms.

The dead are ordinarily thrown into the bush and are eaten by hyenas and jackals, but the bodies of very young children and very old men and women are buried in the manure heap near the kraal. No particular sorrow is expressed, as the former have not had time to become defiled, while the latter have completed their allotted span, and are said to have departed to the place of spirits according to their expectations. The old people are sewn up in goat skins, a man being laid on his right side, a woman on her left side, in each case with a hand supporting the head; beer, milk, a horn of snuff and food are placed with them to assist them on their journey. Prayers are offered to the dead that they will look after the welfare of their descendants. If the body cast in the bush has not been devoured by carnivora after two days when visited, a goat is killed and placed on or near the body to attract them. If the body continues to remain untouched by the hyena, it is assumed that death has been caused by witchcraft, and a "divine" is requisitioned to fix the responsibility. On the death of a married man the widows and unmarried daughters lay aside their ornaments, the eldest son wears his garments inside out, and, before the new moon, the near relatives shave their heads, and the more distant that portion over the ears. When a married woman dies the youngest daughter wears her garments inside out, and other relatives put oil on their ornaments and shave their heads. Following the death of the head of a family, and when the moon is in its last quarter, an ox is slaughtered, friends and relatives eat it and oil their garments. The paraphernalia of the deceased is not used but broken up and rendered useless, as it is considered that to use his effects would annoy the departed spirit. Persons dying of smallpox or an infectious disease are left in the huts till eaten by hyenas, when the huts are burnt and the site never again reoccupied. Among the many ceremonies that take place before the funeral is the "funeral feast." Every relative must then show his good will by giving the dead person a drink of milk, and administer the last

blessing. In this all the relatives must grease the head and face of the deceased, and the latter must reciprocate the blessing by greasing the heads and faces of his anointers, his hands being worked for the purpose by the master of ceremonies.

An after-existence is believed in, and the spirits are considered to reside under the earth with their cattle. All are believed to meet there, but there is no idea that families are reunited. The shades of the dead walk the earth, watch over the living and protect them from injury. There are bad shades that destroy the living in order to obtain possession of their cattle. The shades appear to pregnant women at night, and the child when born is believed to be the shade reincarnated and afterwards bears its name. Reincarnation is only effected in grand- or great-grandchildren. Sacrifices are often made to the spirits of the dead, especially in sickness or trouble, as it is believed these are caused by spirits who generally persecute the living and who have not been appeased.

No reliable figures are obtainable as to fertility. Children are usually nursed till another is conceived. The proportion of males to females is approximately four to five. There is a big infantile mortality due to careless feeding with a sour gruel made from wimbe. Abortion measures are known to be practised and often with fatal results.

(*To be continued.*)

ARMY HYGIENE ADVISORY COMMITTEE REPORT No. 2.

An Investigation on the Motion Study of Digging and the Energy Expenditure involved, with the Object of increasing Efficiency of Output and economizing Energy.

By Captain A. G. STEVENSON.
Royal Army Medical Corps.
AND
Captain R. L. BROWN.
Royal Engineers.

(*Continued from p.* 434, *Vol. XL.*)

SECTION III.

STANDARDIZATION OF THE RESULTS OBTAINED IN A DRILL.

From the results of the preceding two sections we were now able to formulate methods which we considered would be the best under average conditions and for the average man.

Obvious faults were eliminated and also all unnecessary movements. Necessary movements we attempted to improve.

By a gradual process of experimental test we eventually arrived at the following conclusions as to the best methods, which we have incorporated in a drill.

(1) Shovelling.

General Points of Importance.

(*a*) A rhythmical action is essential.

(*b*) The feet should be moved as little as possible and only when it is necessary to advance farther towards the soil to be shovelled. The keeping of a proper stance is the main factor in maintaining good balance.

(*c*) The forward hand should grip loosely throughout the complete cycle and should only allow the helve to slide through it in throws over four feet, the distance of the slide progressively increasing as the throw lengthens, but never to any great extent.

(*d*) Aids should only be employed when the condition of the soil or of the trench base necessitates their use.

(*e*) The shovel blade should never be thrust into the pile of material but always below it and along the trench base.

(*f*) The important action in shovelling is the swing back after the shovel pan is loaded. The trunk should remain bent and only be allowed to straighten during the upward throw.

(*g*) In the final throw the degree of straightening of the back depends on the height of throw. For a throw below four feet little straightening is necessary. After four feet the degree increases in relation to the height of throw and stature of the individual.

(*h*) To ensure the material on the shovel being thrown in a compact mass, the T-piece should be slightly raised at the moment the load leaves the pan, this being particularly important in a long throw.

(*i*) Alternative right- and left-handed shovelling should be employed—this is only a matter of training. Also the grip of the forward hand may be reversed occasionally to afford relief from the usual grip.

SHOVELLING.—Positions and Actions.

Proposed Method.

1

Ready.

2

Swing.

3

Fill shovel.

4

Depress T-piece.

5

Backward swing prior to cast.

6

Cast.

Fig. 4.—Side view.

(*j*) In a vertical throw of six feet or over or a horizontal throw of eight feet or over efficiency quickly decreases. The rate of shovelling at these distances should be lessened.

The earth is given its vertical movement by the straightening of the back and knees, its horizontal movement by the transferring of the body balance from the rear to the forward foot.

(*k*) The earth to be shovelled should be well loosened first with the

pick and no attempt should be made to shovel imperfectly loosened material. At the end of a shovelling period clean out the remaining soil by scraping the loose earth together and throwing it out.

This keeps a good smooth base and makes for efficiency.

(*l*) The shovel should never hit or rest on the object (e.g., brim) which is receiving the material shovelled.

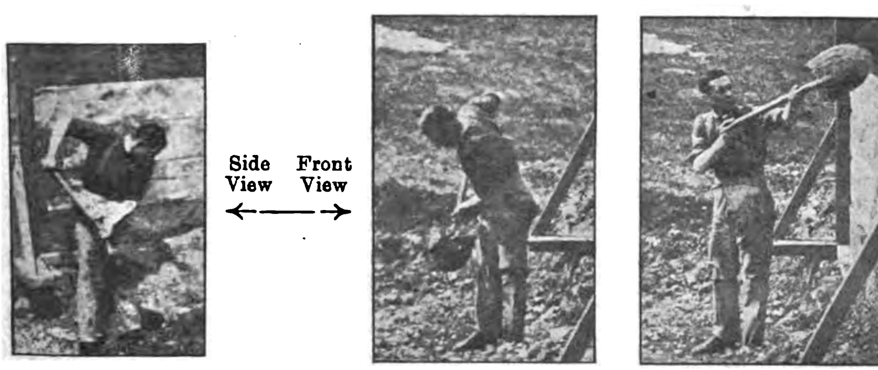
SHOVELLING.—Positions and Actions.

Backward swing. Cast Cast.

A Long Throw. A Low Throw.

Present Method.

Showing difference in action from Proposed Method.



Backward swing prior to cast. Cast.

Fig. 5.

(*m*) The optimum rate of shovelling in a well loosened medium type of soil is nineteen throws per minute with the R.E. shovel. In a heavier soil (stony or wet) aids should be employed and a rate of seventeen throws per minute is about the best.

(*n*) The optimum length of shovelling spell is from two to three minutes.

(*o*) Generally speaking, the greater the shovel-load the more efficient the worker. This factor depends on how the earth has been picked, and how the shovel blade is thrust below the soil.

SHOVEL DRILL. (See photographs in fig. 4.)

Shovelling : Right-handed. (For throwing to the left or front.)

Words of Command.

Ready.—Assume a position as follows :—

Left foot pointing directly towards, and two inches from, the earth to be shovelled.

Right foot to the rear of left foot, about twelve inches to fifteen inches from heel to heel, feet at an angle of 70° to 80°.

The body in an easy upright position with the arms hanging loosely holding the shovel horizontally across the front of the body.

Grasp the T-piece of the helve in the right hand with the thumb round it. Grasp the helve at the bend near the pan with the left hand, palm upwards.

(1) *Swing.*—Swing the shovel backwards and bring the weight of the body on to the right foot. Bend both knees slightly and incline the trunk well forward.

Left arm straight and left hand below and in line with the right knee.

Right arm bent so that the shovel pan points towards the base of the loosened earth.

(2) *Fill.*—Swing the shovel and body forward so that the pan slides along the base and below the loosened earth, bending the left knee and bringing the weight of the body behind the thrust.

Aids.—(In heavy soil and rough base.) Place the front of the left knee against the left forearm, and the inside of the right thigh just above the knee against the back of the right hand.

Bend both knees with a crouching movement and bring the weight of the body behind the thrust.

(3) *Handle Low.*—Depress the T-piece of the helve with the right hand to free the shovel-load from the pile of earth.

(4) *Swing.*—Swing the shovel backwards, raising the load only just sufficiently to clear the ground by a slight straightening of the knees until the pan is over the right toe, keeping the left arm straight, and pan level. Bring the weight of the body on to the right foot.

(5) *Cast.*—Cast the load away by a forward, upward and slightly lateral swing of the trunk and arms to the left bringing the balance on to left foot.

Left arm kept straight, right arm directing the shovel pan and bending to a right angle at the top of the throw.

The body partially or entirely straightened according to the height of the throw.

Rate, eighteen to twenty throws per minute.

With aids, sixteen to eighteen throws per minute.

Shovelling : Left-handed. (For throwing to the right or front.)

The position of the feet and the hands and the action are reversed.

(2) Picking.

General Points of Importance.

(*a*) A rhythmical swing is essential, and the proper timing of the stroke so that all forces are brought together as the pick-head strikes is to be aimed at.

(*b*) The feet should take up their proper stance and not be moved until it is necessary to advance or move laterally to approach new ground to be picked. Balance is thus favoured.

PICKING.—Positions and Actions.

Proposed Method.

1

2

Back of swing.

3

Contact with soil.

4

Breaking the soil.

Raking down the broken soil.

Fig. 6.—Side views.

(*c*) The forward hand should grip the helve *loosely* during the complete cycle except at the actual moment of striking the soil.

(*d*) Overswinging is the commonest fault. It upsets balance and for the energy used up does not produce a proportionate output.

(*e*) To check overswinging the forward hand should adjust its position on the helve as the perpendicular position is reached; this prevents the dropping of the pick-head behind the shoulder.

(*f*) The forward hand slides down the helve during the downward stroke to an extent depending on the level of the ground to be picked, e.g., ground on the feet level; hands should be a few inches apart, say six inches; ground about knee level, hands should be about twelve inches apart.

(*g*) At the moment of striking both hands should grip the helve tightly, thus conveying the full force of the arms and body momentum to the pick-head.

(*h*) The raking stroke, though not always necessary, should always be included in the drill. It enables the soil loosened by the pick to be drawn down to the trench base and thus clears the way for the next stroke. The

PICKING: Positions and Actions.

Present Methods.

To show differences in Action from proposed Method.

Back of swing.

Contact with soil.

Fig. 7.—Front views.

raking stroke should be repeated if necessary, chiefly at the end of the picking spell.

(*i*) Except in very hard stony soils the pick point should never strike twice in the same spot.

(*j*) Pick systematically keeping the sides and base of the trench trimmed and flat. This makes the shovelling spell easier.

(*k*) Endeavour to work on a straight face never less than six inches deep, and where possible between twelve inches and eighteen inches deep.

(*l*) The optimum rate in medium soils is about twenty-eight strokes per minute, but naturally varies in harder or softer soils.

(*m*) The optimum length of spell is about one-and-a-half minutes in medium soils, varying in softer or harder soils, e.g., in very soft soil, less than one minute; in very hard soils, over two minutes.

(*n*) It is a factor of great importance to have the pick point kept sharpened.

PICK DRILL.

Picking: Right Hand Forward. (See photographs in fig. 6.)

Words of Command.

Ready.—Take up position as follows:—

Right foot pointing towards and about one foot from the earth to be broken.

Left foot to the rear about twelve inches from heel to heel.

Feet at an angle of 75° to 85°.

Assume an easy upright position.

Grasp the small end of the pick-helve with the left hand, the right hand loosely holding the helve about four inches from the pick-head.

Arms hanging loosely with the pick horizontal across the front of the body.

(1) *Raise.*—Fix the eyes on the point where the pick will strike the earth.

Raise the pick upwards until the right upper arm is horizontal; right elbow bent to about 90°; left arm slightly bent and carried forward and across the front of the body, adjusting the grip of the right hand so that the centre of the pick-head is vertically above the right shoulder.

Hands about twenty inches apart.

Weight of the body on left foot with head and trunk slightly inclined forwards.

(2) *Strike.*—Keeping the eyes on the point to be struck, make a forward and downward thrust with the right hand, gripping loosely, and allowing the helve to slide through the right hand from six inches to twelve inches; at the same time make a downward and inward pull with the left hand, gripping tightly; incline the trunk forward and bring the weight of the body on to the right hand, at the same time slightly bending the right knee, and bracing the left knee.

At the moment of impact both hands should grip the helve tightly.

(3) *Break.*—Force the small end of the helve upwards and away, sufficiently to loosen the earth, and slide the right hand up the helve to within six inches of the pick-head.

(4) *Rake.*—Rake the loosened earth towards the feet by pulling the pick backwards with both hands, and at the same time transfer the weight of the body on to the left foot.

(1) *Raise.*—Raise, straightening the right knee and trunk and continue.

If necessary, the rake may be repeated again before "raise," by carrying the pick forward again and raking.

Rate, twenty-eight to thirty strokes per minute.

Picking: Left Hand Forward.—The position of the feet and hands and the action are reversed.

(*To be continued.*)

Clinical and other Notes.

THE EFFECTS OF QUININE THERAPY ON THE BASAL METABOLISM IN THE TREATMENT OF HYPERTHYROIDISM.

By Majors J. HEATLY SPENCER and N. V. LOTHIAN.
Royal Army Medical Corps.

The following case was observed at the Queen Alexandra Military Hospital over a period of three months :—

Gdsm. G., aged 22, admitted on November 18, 1922, as a case of suspected early Graves' disease.

Clinical condition on admission.—Patient was suffering from general nervousness, tremors, tachycardia, and sweating attacks associated with enlargement of the thyroid. No ocular signs were present. Temperature was irregular.

Tests.—(1) Goetsch strongly positive.

(2) Quinine tolerance markedly increased. Patient had never taken any quinine before. He was put on an initial dose of quinine hydrobromide of fifty grains per day and subsequently tolerated forty grains per day for sixteen days without any symptoms of cinchonism.

(3) Basal metabolic rate: December 4, 1922 + fifteen per cent; December 8, 1922 + twenty-five per cent.

Treatment was directed towards restoring the normal metabolic rate and was begun on December 9, 1922 :—

(1) Rest in bed on a fat-free diet.

(2) Quinine hydrobromide, forty grains daily.

(3) Cod liver oil with malt extract, four ounces daily.

Treatment was stopped on December 25, 1922.

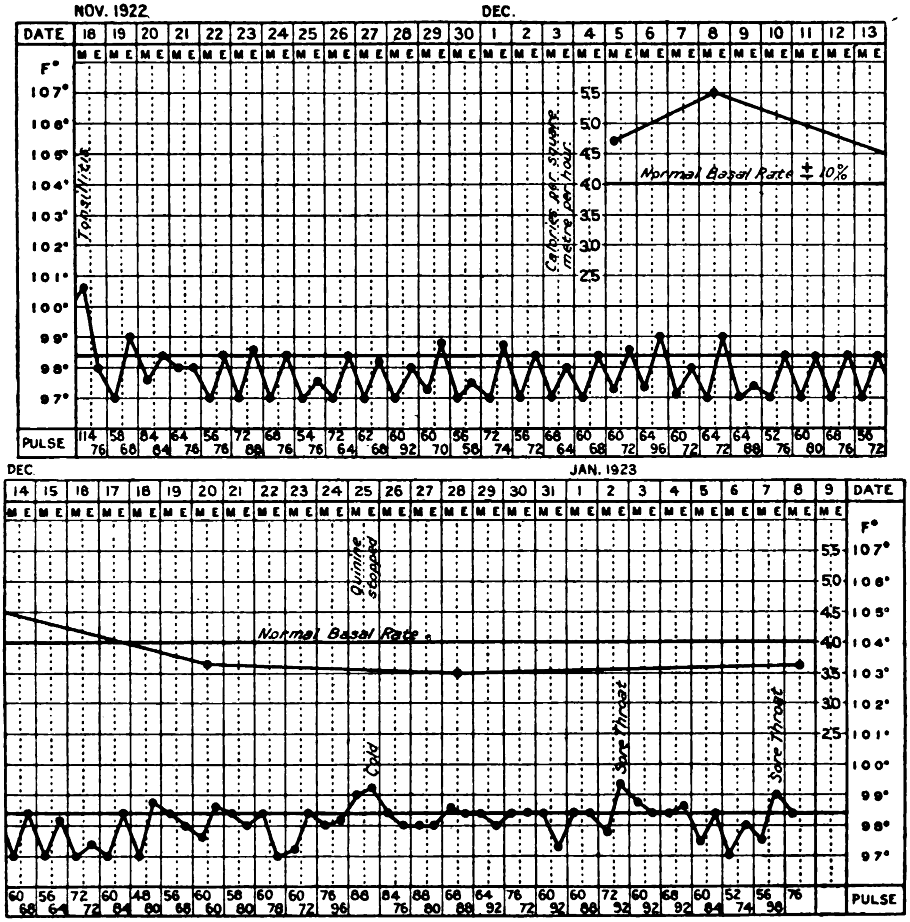
Basal metabolic rate tests: December 20, 1922 − fourteen per cent; December 28, 1922 − fifteen per cent.

Patient was allowed up on ordinary diet between December 31, 1922, and January 8, 1923.

On January 8, 1923, basal rate was − five per cent.

The clinical condition had greatly improved, tremor and tachycardia had ceased and the temperature was approximately normal with marked decrease in the amplitude of excursion. The thyroid had definitely decreased in size. Sweating continued but was confined to the legs. This symptom continued for some weeks and it is of interest to note that in another case of Graves' disease (six months after hemithyroidectomy) persistent sweating was associated with a minus basal metabolic reading becoming less marked on exhibition of thyroid extract.

The chart shows the metabolic curve while under treatment. The change in the amplitude of excursion as the condition passes from one of hyper- to hypothyroidism is well shown.



Although it has been impossible to save this man for the Army, there are reasonable grounds for claiming that the onset of a definite Graves' disease has for the present at least been prevented.

SAND-FLIES.

By Colonel C. J. O'GORMAN, D.S.O.
Army Medical Service.

Official records state and medical officers with experience of sand-flies believe that sand-flies pass through the ordinary 16-mesh mosquito-net.

I have not met a medical officer who had seen a sand-fly pass through a 16-mesh mosquito-net. I do not expect I ever will. The following information

may save expense to junior officers, who believe what they read in official books.

In Peshawar from 1910 to the end of 1912, I studied the habits of sand-flies. I have during the daytime in the hot weather watched sand-flies outside a 16-mesh net, but they failed to enter although I exposed my arm to them as a bait.

At night I used a muslin net, but found I was frequently bitten. I came to the conclusion the sand-flies were inside before I went to bed. I then had my bed always made up during the daylight on the lawn, all bed clothes were very carefully shaken first. I used an ordinary 16-mesh net and I was never again bitten in bed at night. Experts disagree with me, but junior officers in sand-fly areas can experiment for themselves, save money and possibly a great deal of discomfort.

Sport.

A NOVICE'S FIRST SHOOT IN THE CENTRAL PROVINCES.

By "MEDMILES."

In these strenuous days when money and leisure are so scarce and recreation so expensive one's thoughts often turn with regret to the old "pre-war" times when spare time was plentiful and responsibility generally rested more lightly on one's shoulders.

Picture a cold weather morning in the jungles of the Central Provinces, probably the most perfect climate in the world between the months of December and February, a free day in front of one and the station with its many duties and daily round far behind.

The previous evening after handing over our work to an obliging brother officer, we had driven out some 30 miles from a small Military Cantonment—the Engineer and self with our gun cases in one tonga and our respective "bearers" accompanied by the usual miscellaneous collection of pots, pans, valises and empty kerosene oil tins which accompany the Sahib on shikar bent, in another.

We were not able to turn in until a late hour and are with some difficulty roused from a heavy and well earned slumber by the monotonous chant of our factotum "Sahib! Sahib! Chota hazri tiar hai" (Breakfast is ready). Reluctantly we turn out and after a hurried splash in icy-cold water in a tin bath of inadequate dimensions, partake of our tea, toast and eggs the while our henchman completes our toilet with his usual deftness by the light of a hurricane lantern.

It is still dark and a star or two shines faintly through the doorway of the dâk bungalow where we have taken up our quarters. The dim light of the false dawn throws into silhouette the outline of the forest trees some hundred yards away. It is bitterly cold to our blood, thinned by some years' service "east of Suez." Before we are quite awake we find

ourselves in the compound or garden of the bungalow. A shadowy group of beaters headed by old Ali our Shikari appears out of the darkness and we silently wend our way through the gate and across the high road towards where the teak trees show dimly against the sky.

The ground is soaked with dew and even the treacherous teak leaves give no sound as we tread over them with our rope-soled boots. In a few moments we are on a narrow jungle track and proceed in Indian file between the shadowy tree trunks.

It gradually grows lighter; the sky turns from black to grey, green and pink, and soon the sudden golden glory of an Indian dawn blazes in our faces; objects show up in a surprising way and the numerous thorn bushes can be avoided in good time.

The high grass, burnt yellow even thus early in the year, rises nearly to our shoulders as we pass. Our sloth falls from us and we tingle from head to foot with anticipation as we pursue our way on this the writer's first experience of heavy jungle shooting, his previous efforts having been limited to black buck stalking in the open.

We now turn into a narrow game path leading to the river. The rapidly drying dust is dotted here and there with the foot-prints of animals great and small; here a wild boar has wended his "devil-may-care" way; there the small deep-cut spoor of a cheetal (spotted deer) is seen, and farther on the "pug" marks of a large panther cross the track. The prints of sambhur are also plentiful, some quite fresh.

A sudden high-pitched bark followed by a crash in the bushes on our right pulls us up with a jerk and we just catch a glimpse of the bobbing sterns of a small herd of cheetal which we have unwittingly disturbed on their way back from their morning drink.

By now the day has fully dawned and the level rays of the sun are somewhat trying.

We soon reach the river bank which here winds its placid course between steep miniature cliffs of soft sandstone. The stream is shallow with a gravelly bottom and numerous sand banks appear on its mirror-like surface.

The impression rather than the sight of a long low shape slipping noiselessly into the water makes us consider with momentary distaste the long wade which lies in front of us, but the shallow stream is crossed without incident. Mugger (crocodiles) never attack man unless in deep water, and our party of armed coolies makes a formidable array.

The Sapper and I climb the opposite slope—no need to bother about wet feet: the sun will soon dry them.

The beaters now file off towards the left on a long detour which will presently bring them opposite to us and some two miles away. We take our places about 100 yards apart with our backs to the river and facing the jungle which commences some fifty yards farther on, the intervening ground being open save for a few scattered thorn bushes.

Now commences the usual long wait. Not much is expected of this first beat, though the usual yarn of an immense sambhur having been seen in the neighbourhood only two days since lends a certain amount of excitement to the situation.

As a matter of fact shooting in the heavy jungles of the Central Provinces is always exciting, even when out after non-dangerous game, one never knows what may turn up. Every noise or snap of a twig may mean the striped "lord of the jungle" himself or the omnipresent but elusive panther, or failing these the record stag for which we all long and seldom obtain.

Sitting down on a small grassy hillock, left shoulder towards the jungle, an elbow on each knee and our rifle cocked and ready we await developments. All is perfectly still, though the occasional rustle of the dry grass in the slight breeze keeps our senses on the alert. The sun has now climbed higher and no longer dazzles our eyes beneath the brim of our old Cawnpore topee.

Neither of us being greatly blessed with the good things of this earth, our armament is small but to the point. No trusted retainer stands at our elbow with "the heavy 8-bore" with which to administer the *coup de grâce*—we have one "hand-gun" apiece. The maker of roads is armed with a brand new H. V. 0·400-bore express rifle—the joy of his heart—for the gaining of which many small economies have been necessary. But for the writer freshly delivered from the hands to the "shroff" and the proud possesser of two indifferent polo-ponies, such luxuries are not—his weapon is a borrowed and second-hand 0·500-bore double-barrelled hammer express of ancient pattern firing low pressure cordite cartridges. It is however a handy weapon little heavier than a shot-gun and firing a bullet of satisfactory dimensions. Although facetious friends had maintained that they could hear the bullet rattling down the bore when discharged, it is an accurate weapon up to 150 yards when tried on the range, and what more is necessary? Quite a considerable head of game had fallen to it already and it had never let its owner down. Of this more anon.

Suddenly the distant clamour of the beat is heard now about a mile away. Try as we will we cannot educate these hastily gathered coolies to the more effective method of the silent beat. They prefer their own, and one can hardly blame them. They are not "jungly" men and do not desire a too close acquaintance with its dangerous denizens if such be about.

The rifle is raised in readiness and we watch the jungle with closer attention, straining our eyes to search the undergrowth. All at once the dark form of a sambhur doe appears as if by magic on our left front, its lean head with widely splayed ears looking suspiciously over a bush. After a pause she plucks up courage and steps gingerly into the open followed by two smaller does—a distant yell helps to make up their minds

and at a clumsy canter they cross the open, passing between us and fording the river are lost to sight in the jungle behind us.

Our attention returns to the fringe of the forest. The noise of the beat is now some 600 yards away. A hare scuttles hurriedly across the open and with a rush and a whirr a fine peacock sails over head, its brilliant plumage and long streaming tail shining in the sun.

Something attracts our attention in a small clump of trees to our right front. A moment and the "something" suddenly discloses the body of a large sambhur standing in the shadows some fifty yards away. Slowly we swivel round and cautiously the rifle comes up—a deep breath and the foresight lies against his right shoulder, but we cannot fire, his

An awkward moment.

head is masked by the interlacing branches. He may be a "young 'un" destined to give some other shikari a day's sport some years hence. The horns may be found worthless, so we must wait. Stealthily he advances through the saplings but bearing away to our right where the jungle approaches more nearly to the river bank. Obviously an old hand at the game he takes no chances, no headlong rush across the open for him! Carefully we turn still further and suddenly he vanishes! One eye has left the target for a second, and the back-ground has swallowed it up. A twig snaps further away—no use changing ground now—the open is being watched by a pair of keen eyes and any movement will betray us. (Why will game nearly always break on the wrong side?) We watch intently—

nothing is to be seen. After a minute or two a stone rattles farther down the river bank and there he is—the sambhur of our dreams! fully 200 yards away splashing through the shallow water at full gallop; neck outstretched, his heavy horns lying along his neck, a "forty incher" at least and heavy to boot. Hurriedly we pushed up the back sight, the foresights rest on his shoulders and swing forward six feet ahead of him, slowly we press the trigger—BANG! a miniature geyser of water, sand and gravel flies up under his feet—the bright sunlight has made us under-estimate the range which was too far for a sporting shot; but *humanum est errare*, we had to have a try! With a bound he is in the jungle on the far bank and out of our ken before the second barrel can be fired. He will put many miles between us ere he slows up from that lolloping gallop. For once rumour had proved true, but the fine head was not destined to grace the colour-washed walls of our decrepit bungalow in cantonments.

Silently we anathematize our luck, our bad shooting, the sambhur and everything else and await the arrival of the beaters who are now quite close. Soon their dirty pagris and brown faces appear through the trees and the beat is over. We stretch our cramped limbs and walk over to our friend who is loud in his commiserations; thorough sportsman that he is, he does not grumble at his own luck which was even worse than ours, as, saving the sambhur does, he had seen nothing.

The beaters are formed up at right angles to the stream and squat down for a well-earned rest while we move off along the river bank, our destination being a branch nullah some one and half miles away.

The walk beside the river bank was not without interest; we proceed along the miniature cliffs with the jungle on our left, rifles ready for a chance snap should something worth while appear.

The sluggish forms of several mugger and the fish-eating gorial are seen on the banks, and here and there the turtle are rising in the deeper pools. Eventually we reach the branch nullah and crossing its dry bed we turn left handed along its farther bank and proceed for another mile away from the main stream. The jungle here is more open and small hills appear, the heavy teak forest gives way to more open country dotted with thorn bushes and small trees. We toss for the best place and the writer wins, choosing a likely-looking spot—overlooking a natural ford over the ravine where the low cliff is scraped away on either side and where any game driven towards us are likely to cross.

The sun is now distinctly hot and we sit down with some relief under the shade of a small neem tree overlooking the ford long since dry. The maker of roads taking up his position about a furlong farther on.

The outlook from our position is scanty: we can see only the ford, and the low cliff on the opposite bank fringed by a row of bushes and thorn scrub.

The effects of yesterday's long drive and our early start make them-

selves felt and a not unpleasant drowsiness envelops us, when after an interval our eyes suddenly catch a movement among the bushes on the opposite bank some seventy yards away. The patch of light between two trees is darkened for a moment, we watch intently, another movement and there he is! a fine cheetal stag creeping quietly along, antlers laid back and treading like Agag among the dry undergrowths, pausing every now and then to scan the surroundings. Suddenly he stops broadside on and waits. Surely he is our mutton! Slowly the rifle comes up steadied by an elbow on each knee, a deep breath and the foresight stands steady on the crease of his shoulder—we press the trigger—a loud report a crash and the sound of scrambling and threshing in the river bed, when up the banks comes the stag at full gallop and tops the rise only five yards from us. Hurriedly we snap off the left barrel scoring an obvious miss, and away he goes only to suddenly collapse and roll over fifty yards behind us! We rush up hurriedly reloading as we go and find him stone dead. Our first shot had struck him in the right spot and there he lies, a fine head indeed. (On measuring later the horns were found to be thirty-five inches.)

We sit down and mop our brow. At last success has crowned our efforts and our first cheetal lies before us. Man is a callous creature and the feeling of regret that must assail everyone on taking life soon vanishes. The beaters presently arrive and a thermos and sandwiches are produced. Our friend is even more pleased than if he had bagged the stag himself. Again he has had no luck. After a heated argument he agreed to take the best spot in the next beat.

We presently continue our walk along the nullah bank to a spot some two miles away and then crossing some low rocky hills take up our position about two hundred yards beyond, sitting in the open amongst some stunted thorn bushes, my friend's position being nearest a "nek" in the hills. Again we sit and wait. To our front is a level stretch dotted with scrub and beyond is the rocky ridge crowned by two or three withered trees. The time drags somewhat and nothing happens. It is very silent and the heat rather oppressive. A clatter among the rocks in front and a small herd of Nilghai headed by an old blue bull appears. We view them with scant interest: we have already shot a solitary specimen of this somewhat uninteresting antelope. They approach nearer and reach the level ground. All at once our interest revives and changes to annoyance; apparently not noticing the seated figure under the bush, they gallop straight on like a group of cavalry, and master is sent flying in a most undignified way, knocked endways in fact; his rifle and topee flying in different directions as he bites the dust. A kick from a galloping hoof completes his discomfiture and annoyance. Thoroughly out of temper he scrambles up and seizing his rifle fires into the hind-quarters of the old bull, who collapses in a heap.

We resume our topee and sit down again now full in the open as the noise of the beaters is heard just beyond the hill in front. The "Honk"

is practically over. Still somewhat ruffled and sore we wait for the men to appear. Our attention is suddenly focused by a round object which appears for a second above a boulder on the hillside; our doubts are soon dispelled as a large member of the cat tribe, but whether tiger or leopard is uncertain, comes into view and leaps down the rocks. This is our first sight of dangerous game except through the bars of a cage. It reaches the level ground, stops, has a good look at us and then advances deliberately in our direction. As it approaches we see it is an enormous panther. It is head on and nears us at a slow walk, pausing occasionally to look back over its shoulder and apparently well cognizant of our presence. It is now only fifty yards away and still coming on! Tips gleaned from various Shikar books flash through our head: "Never fire at a dangerous animal approaching or it will certainly charge, wait till it is broadside on." He is now only twenty yards away, occasionally stopping to stare at us as he advances. Shall we have a go at him and trust to luck or shall we wait? The foresight covers the front part of his shoulder, but our hand is not quite as steady as we should like; he is now only fifteen yards away and distinctly irritated! His tail switches from side to side, a low growl escapes him at intervals and I get a glimpse of very unpleasant yellow teeth. Suddenly he turns slightly away, presenting a broadside shot. Now for it! We still wobble somewhat and our foresight traces a figure of eight on his shoulder—we steady ourselves with an effort and press the trigger—at the same moment a loud yell from the beaters causes the panther to start forward—BANG! He stops after his leap to look at us with what seems a contemptuous expression! Not a sign of a wound appeared on his glossy coat. Hurriedly we press the second trigger—there is a click and nothing happens!—a misfire. Feverishly we try to open the breach, it refuses to move; the rifle is jammed! We wrestle with it in vain. The panther emits a blood-curdling snarl and crouches for a moment. There is nothing to be done, we sit and look at him and he at us. After a pause, which appears to last several hours, he growls again and leaps into the jungle beyond, from which emerges, with the precipitance of a jack-in-the-box, one of the back stops, his dark face green with fright. He had had a narrow escape as the panther nearly knocked him down in his leap.

Another beat is quickly formed and we hurry through the jungle to try and get ahead of the "Tendwa," but he has outdistanced us and the result is a blank, as is the second effort. Sorrowfully we pack up and wend our way towards our dâk bungalow, where the sight of my cheetal restores cheerfulness, helped by one of the marvellous five-course dinners which our Aryan brother appears to be able to produce from practically nothing; and so ends the day!

Net results: a fine cheetal and a lesson in the use of old-fashioned and part-worn hand-guns. And last but not least, that feeling of personal well-being which only those who have worked hard in the open air, with a spice of risk thrown in, can properly appreciate.

Travel.

SICK LEAVE: A SEARCH FOR HEALTH.

By Captain J. C. BURNS.
Royal Army Medical Corps.

It was during July that I found myself a patient in hospital in the Fort at Delhi, and life at that time was anything but cheerful, despite the comfort of the ward and the care and attention of the staff. Hot by day and hot by night, one lived in a bath of sweat and irritation, the evening peg of whisky bringing the one moment of relative peace.

To-night however all was well—the air seemed cooler, the electric fans worked better, the bringal cutlets tasted less insipid than usual—in fact, I was feeling thoroughly pleased with life, for a delightful prospect was opening before me. Twenty-eight days' sick leave! Such was the cheering news delivered to me by the C.O. on his evening visit to the wards. Leave to the hills meant more to me than many others who were already satiated with India and the Indian; but to me it meant the realization of many dreams. As hot weather succeeded hot weather in the scorching plains of Mesopotamia, I drank in with increasing avidity those glowing tales of leave in Simla, Murree, Gulmerg, Mussouree, and Naini Tal, told with gusto by subaltern and senior officer alike. There were tales of good cheer, of golf and tennis, picnics in the hills, dances, glorious scenery, the sight of the snow by moonlight, in fact everything that was in direct contrast to the drab monotony of life in the "blue," and now I was in India.

The C.O. in discussing my leave advised me to go to Naini Tal rather than to Mussouree, for he thought that to one who was so debilitated the latter place would prove too strenuous. It was all the same to me—this my first trip to an Indian hill Station; and moreover, there was a wonderful lake at Naini, a sheet of emerald water reflecting the wooded hills that closed in this jewel in one of Nature's most perfect settings. As if to increase my hunger for the cool freshness of the mountains, the evening had become oppressively hot and close. Ink-black clouds banked up till the whole sky was covered, the air was still and stifling, and a strange hush hung over the city and the palaces in the Fort. A whisper of a breeze from over the Jumna stirred the leaves of the trees in the compound. The breeze strengthened to a cool steady wind, which filled out the mosquito-net like a sail and cooled the skin. The rain came down in torrents, and it was so refreshing to lie and listen to the drops swish through the trees and drum on the verandah roof, and to breathe the cool, clean, sweet air. Next day found me busy attending to kit, etc., in preparation for leaving by the evening train to Bareilly and Kathgodam. The run to Bareilly was very comfortable; arriving there the following morning I found I had to wait till evening for the train to Kathgodam.

The heat of the day was spent in a waiting room with a big electric fan in place of the usual punkah and coolie attachment. A drive round the cantonment after tea left me with the impression that Bareilly would be a very nice place in which to be stationed. Another night was spent in the train, and when I woke about 5.30 a.m. we were nearing the terminus, and the view from the carriage window in the lovely morning sun was charming. There was opportunity for breakfast at the station, while the bearer saw to the stowing away of kit in the motor lorry waiting outside.

Four of us found ourselves comfortably seated in a big Armstrong Siddeley touring car. The first few miles was slow going, as we had to pass an almost continuous string of huge country carts. These, however, changed over from the motor road to the cart road, and with the engine purring smoothly under the bonnet we swung round the corner climbing

ever upwards at a steady fifteen miles an hour. Two of my fellow travellers kept me interested in their tales of the accidents that happen every year on this road—runaway cars, landslips, etc., and comparing them to similar accidents on the run into Kashmir. Such glorious woods clothed the hills, gloomy ravines with fleeting glimpses down the khud of the tiny silver thread of the Kathgodam river opened and closed before us. The journey through those magnificent forests seemed all too short, when suddenly turning a corner we traversed a strip of native bazaar, and the view of lake and hills was spread before us. This perfect picture of water, hills, and forest, the fresh crisp mountain air, and to know that I was to live in such a lovely spot for one whole month filled me with inexpressible delight. The thrill that the sight of the lovely lake of Naini imparted, can

only be compared in intensity of impression to what I felt when first I saw the Taj at Agra in all its celestial beauty, like a pearl bathed in moonlight. The Taj, however, seemed so unreal, the cold loveliness of this "poem in marble" kept one silent, one walked on tip-toe through the stillness of the Eastern night. But here were gorgeous colours, the golden sunlight, the clamour of bearers and coolies, and one's pulse leapt in response to the light and freshness of the day.

What glorious days—and nights—were those at Naini even for a convalescent. The Club boat-house was only 100 yards from the hotel, and at about 7 a.m. the hale and hearty would appear, some to play water polo, others of the strong and silent type with set faces would insert themselves skilfully and carefully into their fragile "shells." Most mornings I found

myself grasping the rudder lines facing an athletic and charming oarswoman, and when the lake was very busy it was bad for one's sense of direction to gaze too long at a point directly ahead, when such a point resolved itself into a pair of large grey eyes. However, everyone who sculls can swim, so none of the accidents were fatal.

Breakfast about 9 a.m. or half past—unless it was a "Europe morning" —was invariably a big meal of many courses, culminating in steak and chipped potatoes. The "Rains" had set in and were rather persistent, so that a whole day's excursion was a risky proceeding. When the weather looked settled for the day, ponies were sent for and a party suitably selected would gather for a ride through the woods to Bhowali, or perhaps Bhim

Thal. These outings were always very cheery and the erratic gait of the bazaar ponies along the edge of the khuds added to the excitement, if not the pleasure, of the ride. Lunch at Bhowali in a tiny hotel, with verandah bowered deep in lovely roses, was always a very pleasant meal, the food was always excellent, and the khitmagar discreet. On other occasions, we rode up to Land's End to enjoy the magnificent view of the plains. The hills seemed to drop away from one's very feet, and the plains of India were spread out to lose themselves in the blue-grey distance.

Picnics on the top of Ayarpatta on a clear day afforded one the everlasting joy of a sight of the snowy summits of the Himalayan ranges, and at sunset, when the air had been washed and cleansed with recent rain, the play of colours on those peaks was fascinating.

The golf course at Government House was a great boon, and a round of golf filled in the interval between tiffin and tea most agreeably, and though the beautiful stretches of turf and thickly wooded glades and ravines were very picturesque, they were a safe resting place for the ball which deviated the smallest fraction from the straight and narrow fairway. Irate "sahibs" and expostulating coolies could always be heard if not seen in those leafy gullies.

On wet days those who wished to keep fit could play ping-pong in the hotel lounge, others took refuge in the Club, where, on certain afternoons, very jolly *thé-dansants* were held. There were on the average three balls a week, so that the dancing man had plenty of opportunities to show his skill.

Polo was more or less limited to those on the Command staff, but there was unlimited tennis, every bungalow having its own court.

My twenty-eight days having almost expired, and acting on instructions, I reported to the station hospital for further examination. It was a wet, grey morning, the hills and lake shrouded in thick mist, which eddied and swirled in the erratic currents of air that swept down from the heights. The sky and earth oozed moisture, but I was cheered with the thought that an extension of leave might be granted—to what an extent, however, I little guessed at that moment. It was a very dismal youth who left the hospital ten minutes later, with a diagnosis of a malady which at the best would mean a life of invalidism, an end to an Army career, and, in the blackness of the moment, an end to everything that previously had made life worth living.

The rain felt more unpleasant and wet, the dandy coolies' sweat more disagreeable than ever before, and my thoughts were bitter indeed.

The certainty that I would be invalided home was consoling, and there was to be a fancy-dress ball that night at the hotel, so after all there was not much to be down-hearted about. At the beginning of September I was admitted to hospital and remained there till November; the weather during this time was simply perfect. October, in particular, was a glorious month, the cold sharp air was most invigorating, the woods were a constant

source of delight, as the greens changed to russet and browns, while every day added to one's feeling of increasing strength.

Passage had been arranged for me on the first hospital ship, and this was due to leave Bombay on November 15.

Accordingly I left Naini Tal on the 10th of the month, and it was with a feeling of genuine regret that I looked my last on the beautiful lake and hills. The journey to Bombay over the B.B. and C.I. Railway was very comfortable, for I had a compartment complete with a full-size clean bath to myself.

The "Vita" was the name of the hospital ship that was to convey the cargo of sick and wounded to the United Kingdom, and very clean and neat she looked in her green and white paint. A lady and two officers, invalided home for the same complaint, were on board, and we were able to form on deck a select little mess of our own, and thus far, the first part of the voyage as far as Port Said, we had a distinct advantage over those who messed in the saloon.

The night before we sailed Bombay was a wonderful sight, all the main buildings and hotels being beautifully illuminated in honour of the visit of the Prince of Wales, who was due to arrive in two days' time.

The voyage was quite uneventful, and the weather was lovely, and warm enough to make sleeping on deck more of a pleasure than a duty. Having gone out from home via the Cape, this was my first trip through the Suez Canal, and I found it very interesting.

We had hopes the ship would proceed to Constantinople to pick up sick, but the order was cancelled, and we carried on to Malta. We stayed long enough to go ashore and visit the chief places of interest. The voyage from here onwards was enlivened by the presence of some R.A.F. officers who were past masters in the art of running sweepstakes and lotteries, and urged on by the eloquent and witty auctioneer, the bidding for the ship's run for the day produced tremendous excitement and much mirth.

Charades and concerts filled up the evenings very agreeably, and a month after leaving India we steamed up past Netley to Southampton.

While in Netley hospital, we were "boarded," and we three "crocks" were recommended transfer to Switzerland. By the middle of January all arrangements were completed, and on a bright crisp morning we left by the boat train from Victoria en route for Davos. We travelled via Calais, Paris and Basle, arriving at Basle in time for breakfast. Here we boarded the Engadine express for Lanquart—the junction for Davos. The journey past Zurich and its lake to Lanquart was interesting, but the beauty of the scenery was dimmed by the grey skies and falling snow. Arriving at Lanquart about 1 p.m., we changed to the electric train on the Rhætian Railway that was to take us up the 5,000 feet among the snowy mountain ranges that towered over the plain. The sun had chased away the clouds, and the brilliant light shining on this land of snow was quite dazzling. The climb up through the mountains was very beautiful, and nearing

Klosters, the sight of groups of visitors ski-ing on the slopes was most exhilarating, while the laughter and shouts from those who took a toss came across the valley with startling distinctness, in the icy air.

To an invalid, the sensations produced by this combination of clear blue sky, dazzling snow peaks and frosted pine woods all sparkling and glistening, under a brilliant sun, were those of excitement and delight, tinged, however, with regret that the thrills of the bobsleigh and the ski were not for us.

At Davos we found the concierge of the sanatorium waiting for us, and we straightway slid through the snowy streets to the merry jingle of the sleigh bells.

I remained at the sanatorium from January to December, and so had an opportunity of seeing Davos and its environs under the varying condi-

tions of the seasons. Unfortunately, 1922 was a bad year as regards good weather, and even the oldest inhabitants could not remember a worse spring, a colder summer, or more cheerless autumn. However all this was mercifully hidden from us in the future, and arriving as we did in such lovely weather, we looked forward with confidence to renewed strength, if not a "cure" in this thin limpid air.

Life, as a patient in a sanatorium, can be either very pleasant or very much the reverse—it is a question entirely of how one reacts to the discipline and self-control, and that is essential in the successful treatment of a chronic illness.

In this sanatorium the rules of the house were enforced, but in comparison with similar institutions the rules admitted of a considerable amount of liberty of action. We were blest with a medical superintendent who was not only in the front rank of lung specialists, but also one who

took the most intimate interest in every patient under his care. It was an object lesson in the application of the methods of inspection, percussion, and auscultation, to see him "going over" a patient. Davos, of course, specializes in sanatoria. There is a Davos Dorf and a Davos Platz, but the two places are now continuous. Davos is in the Canton of the Grisons in a long and narrow valley, and sheltered apparently from any wind that ever blew. As it is at an altitude of just over 5,000 feet it is very cold at night, but during the day the brilliant sun makes sitting out of doors in the depth of winter not only a possibility, but a pleasure. It is curious to note ladies skating on the ice rink, and protecting their fair complexions with a sunshade. The town is kept very clean, and all visitors have to pay a kurtaxe of half a franc daily towards the sanitary services. Members of the medical profession are exempt. The sanatoria and hotels are built on the same plan, long and narrow, the greatest frontage facing south. Rooms on the south front are usually more expensive, but then one has the privilege of living in a sun bath for the greater part of the day. All such rooms have big balconies on which the patient rests extended on a "chaise longue" during the official rest hours. The average periods of rest insisted upon are 9.30 a.m. to 10.30 a.m., 12 noon to 1 p.m., 2 to 4 p.m., and again 6 p.m. to 7 p.m. Breakfast was 8.30 to 9, and the big meal of the day was served at 1 o'clock. Tea at 4 p.m. and dinner at 7 p.m. Milk was obtainable *ad lib.* whenever you asked for it. After a heavy midday meal the afternoon rest hour was a very popular institution, but when you felt very well there was a great inclination to prolong the hours of freedom. The "chief" regulated the amount of exercise one could have, and if for any special reason you wished an extension it was almost always granted, provided it was within the bounds of reason.

The lovely winter weather one associates with the Higher Alps gave way to the dull skies that mean snow, but nevertheless we were able to be out in the open and attend the various big skating and ski-ing championship meetings. During the winter season—the most popular—Davos is thronged with a very cosmopolitan crowd, and it is a very entertaining and amusing way of spending an hour, to sit in the Curhaus Hotel Café about 4 o'clock when visitors are returning from their ski-ing, trailing, skating, or tobogganing adventures. One sees a motley crowd of British, Spaniards, Italians, Germans, Russians, Greeks, arrayed in the most varied "winter sports" costumes, all jazzing vigorously to the strains of the "Hungarian" orchestra, and a fancy-dress ball in the early hours of the morning is a "sicht for sair een."

About the middle of March the thaw was well advanced, and the hitherto immaculate whiteness of the snow on the street and house tops changed rapidly to a dirty grey. The streams were flooded with the snow waters that everywhere trickled and splashed about one. The sleighs gave place to wheeled vehicles and Davos prepared herself for the spring. Spring alas was long in coming, and May was upon us before the skies had

cleared and made the earth radiant with sunshine. It was worth waiting for, to see the glorious verdure on meadow and mountain—the scenery was richer and more varied, and the flowers made a fairy carpet for all to see and admire. Although the summer was not the perfect season of the preceding year, yet one was able to have delightful excursions among the pine woods, and a picnic in the Alps is something to remember.

It is interesting to note that no motor cars are allowed within the Canton, and so the dust nuisance does not exist, although no doubt many tourists miss this convenient form of travel.

The year gradually rolled past, and in October the mountain ranges became whitened, the air was very cold at night, and winter was upon us. By December it became advisable to continue my wanderings in search of health, as the approach of half-pay rendered a more protracted stay in Switzerland impossible. On medical grounds, too, a transfer to other scenes was recommended, and I accordingly arranged to drift down by easy stages to the more genial climate of the Italian Riviera, and, as I thought, to pass my days in lazy content beneath an azure sky, gazing on a torquoise sea. The train journey was via Lucern, to St. Gothard tunnel, through Milan to Genoa, and so to my destination, San Remo. The journey to Lucern was accomplished on a fine sunny day, and afforded me an opportunity of admiring the lovely scenery along the shores of Lake Zurich. From Lucern to the Italian frontier the country was specially fine, but spring and early summer would make this one of the most beautiful panoramas in Europe. Lake and mountains gave place to deep and narrow ravines as we traversed the St. Gothard area, and it was not till three o'clock in the afternoon that the beauty of Lake Lugano spread out before us. The journey had proved rather tiring, so it was more prudent to spend a night at Milan. Numerous brass bands parading the streets playing the Fascisti Anthem to the cheers and shouts from the crowds, kept me awake most of the night. It appears that a municipal election had been taking place, and that the Fascisti had won by a large majority. Hence the jubilation. The country between Milan and Genoa is a plain without a hill or prominent feature to break the monotony—every inch is under cultivation, and the fields are marked off by rows of poplars and willows. At Genoa my friend and I had the good fortune to get a room in a really good hotel—The Miramare. It was at this hotel that the members of the Genoa Conference foregathered, and the hotel barber had many amusing tales to tell of the various important personages who came to him to be shaved, and occasionally shorn. The barber developed a lucrative business in selling the locks of his more famous customers. It was of interest to learn that the silver clippings from the head of the then British Premier commanded top prices. His admirers were so numerous that the supply could not meet the demand, and adulteration had to be resorted to.

From Genoa to San Remo we travelled by car along the "Azure

Coast," and so we were afforded a very pleasing view of the sea. The mountains, ranging from 2,000 to 4,000 feet, slope steeply down into the sea, and promontories profusely covered with palms and the gardens of villas add to the picturesqueness of the coast line. San Remo itself, a town of about 20,000 inhabitants, nestles in the shelter of an amphitheatre of hills, protected from cold northerly winds. For this reason San Remo claims a more perfect climate than any other resort on the Riviera. There are innumerable places of interest and beauty in the neighbourhood, and Monte Carlo is reached by motor in an hour and a half. The roads in Italy, alas, are in a bad state of repair, and dust is a nuisance one could well dispense with.

As week succeeded week at San Remo, I became more and more enamoured of the lovely views of blue waters, the background of dark mountains with their centuries-old villages, and the serried terraces of carnation and rose gardens and olive trees. This is a languid country, and one tends to put off till to-morrow what should be done to-day.

What memories there are to treasure of a sojourn in this delectable land—memories that will cause a heartache from the very intensity of their impressions of golden hours, when time stood still; above, a blue sky and the hot sun streaming through the leaves of olive trees that gave us shade; below was the sapphire sea, touched here and there with the white crest of a breaking wave, and the scent of mimosa in the heated air. As the poet expresses it:—

"Mimosa, flower of memories,
Best loved of all those Southern flowers,
Your pollened gold bids re-arise—
Dashed even then with April showers—
Those bygone days of many hours,
So quietly fled that now they seem
A short mimosa-scented dream."

Echoes of the Past.

THE MEDICAL CRIMEAN GRAVES AT SCUTARI.

By Captain J. F. BOURKE, M.C.
Royal Army Medical Corps.

There is probably no burial ground in the world so beautifully situated as the British Crimean Memorial Cemetery at Scutari. It is perched on a rugged cliff on the Asiatic shore from which there is a superb view of the Stamboul Peninsula, with the Seraglio Palace and San Sophia standing out clear from the tall minarets of the countless mosques. Over the Sea of Marmora, whose waters lap the foot of the cliffs, is seen the confluence of the Golden Horn and the Bosphorus, with the historic Genoese Tower of Galata standing out as a sentinel over Pera, the modern and ultra-cosmopolitan quarter of Constantinople.

To the east are the Princes Isles, whose gleaming white villas contrast against the sombre pine trees and rocks, showing up clear cut in the vivid blue of the Marmora Sea. In the remote background lie the snow-capped summits of the distant Anatolian Mountains.

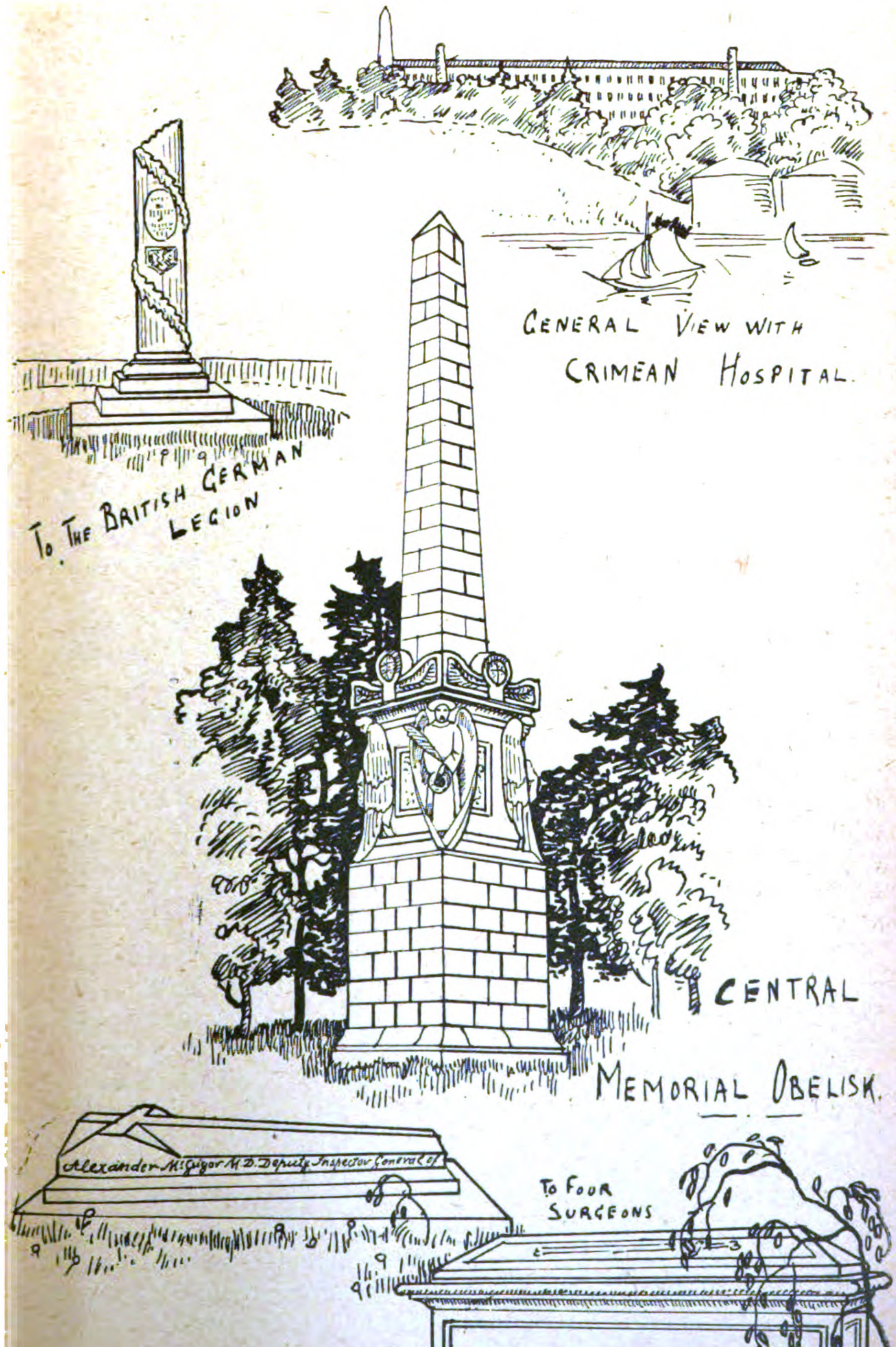
The Cemetery itself is laid out in a style of trim and homely orderliness reminiscent to the exile of many an English country churchyard. It is hard not to contrast it with the desolate aspect of the adjacent Turkish burial ground, which with its countless cypress trees (the emblem in Turkey of the abode of the dead), looks so beautiful in the distance; but disgusts the venturesome sightseer with its litter of crumbling graves, exposed human bones, and pariah dogs, who seem to be awaiting night for all too sinister a purpose.

The Cemetery extends in a rambling fashion over some eight acres of ground, and according to local lore between seven and eight thousand of the British Crimean Army found their last home there during the war period. The big Hospital, the scene of Florence Nightingale's labours, was the intermediate resting place for the vast majority before Death took its toll. The building is still standing, and is used by the Turks as an army hospital in connexion with their Military Medical School.

The Crimean Dead are commemorated by a central massive obelisk of granite which dominates the cemetery and is visible at a great distance from the sea. At about, roughly, a third of the height of the column, facing the four points of the compass, are panels surrounded by great figures of angels with folded wings. Each panel bears in the language of one of the armies (British, French, Sardinian and Turk), allied against Russia, the same inscription. The English version, attributed to Lord Macaulay, reads, "To the Memory of the Officers and Men of the British Army and Navy, who in War Against Russia in 1854, 1855 and 1856, Died for their Country, this Monument was raised by Queen Victoria and her People 1857."

If adversity makes strange bedfellows, war makes no less unexpected friends and adversaries. The rôle played by two of the nations in the Great War is reversed. This is reflected in the broken pillar to commemorate the fallen soldiers of the British German Legion, and the monument erected fifty years later by the Russian Government to the Russian prisoners of war who died in British hands.

There are but few separate tombstones or memorials, the provision of which was left to individual enterprise. The corpses of the dead were interred in long trenches spread with quicklime, as a precaution against infection, as so many deaths were due to cholera, typhus and enteric. As, of the few stones remaining after nearly seventy years, a considerable proportion relate to the Medical Services, it was thought worth while putting on record in the Journal the state of the Cemetery in 1923 before the British Forces left Turkey.


GENERAL VIEW WITH
CRIMEAN HOSPITAL.
TO THE BRITISH GERMAN
LEGION
CENTRAL
MEMORIAL OBELISK.
Alexander McGigor M.D. Deputy Inspector General of
TO FOUR
SURGEONS

The principal mèdical grave is that of "Alexander McGrigor, M.D., Deputy Inspector General of British Army Hospitals. Died at Scutari 16th November, 1855, aged 45 years," as the inscription on his stone reads. Dr. McGrigor joined the Service as an Assistant Staff Surgeon on May 31, 1833. He was posted for duty to the 92nd Foot a few months afterwards. He never served for any very lengthy period with a particular Regiment as was the custom at that time, but enjoyed a considerable variety of service. Before being promoted to Surgeon to the 71st Regiment in 1843, he had served as an Assistant Surgeon with the 32nd Foot and the Royal Canadian Rifle Regiment. In 1852 he was transferred for duty with the 6th Dragoons. Promotion came to him as a 1st Class Staff Surgeon early in the War. His next appointment was Deputy Inspector General of Hospitals, for which he was selected some nine months before his death.

His gravestone, which is still in excellent preservation, lies in a sheltered corner of the Cemetery surrounded with trees and shrubs. Next to him rests a Crimean Naval Surgeon, while the grave of a doctor in the British German Legion stands a few feet away facing his corner.

There is a combined memorial to four Surgeons and single memorials to fourteen other members of the profession. The Nursing and Hospital Personnel are represented by Memorials to one matron, three nurses and to one purveyor, one steward and one dispenser. For the sake of completeness and record a list is given in the Appendix of the names on the memorial or grave stones still existing, with a note from the inscription where any matter of particular interest appears. In only one instance is the cause of death noted, and that is in a case of cholera. Ages vary very greatly. One Staff Surgeon was sixty-one years old, and two Assistant Surgeons twenty-two, and another twenty-three at the time of their death.

The planting and planning of all the gardens, borders and trees was personally supervised by the first custodian to be appointed, the late Sergeant W. H. Lyne, formerly of the Royal Engineers, who found his life's interest and work in beautifying the ground which he had taken over as a wilderness, dominated by the obelisk and surrounded by a bare wall. Landing in the Levant during the Crimean War on his twenty-first birthday he suffered from typhoid, and was tended in the Scutari Hospital by Florence Nightingale. He was subsequently appointed to the Hospital staff. For the great period of fifty-eight years he worked within a stone's throw of the Hospital he knew so well.

After the Crimean War, the British community, who had previously utilized the Ferikeui international graveyard, commenced to bury their dead in this cemetery in the seventies and took over its control and maintenance.

During the Great War the historic explosion on August 6, 1917, at

Haidar Pasha Railway Station, of Turkish ammunition destined for Palestine, besides having a decided effect on the campaign, did some damage to the cemetery which, though not the object of any organized plunder, was despoiled of trees and damaged by the swarms of Turkish soldiers quartered in the enormous Selimlieh barracks or camped in the neighbourhood. Whilst this is being written the gigantic barracks, capable of holding more than 10,000 troops, is the scene of a vast tragedy. For many days past an average of forty corpses a day have been brought out from amongst the wretched semi-starved Greek refugees huddled in misery in these buildings. These unfortunate people were evacuated from the Turkish interior and are awaiting passage to Greece, already overburdened well nigh to breaking point with refugees with whom she cannot cope. For too many years the refugee has been a permanent tragedy of the Balkans and Near East.

During the war some seventeen British and Indian prisoners of war found their last resting place at Scutari, including eight who had been brought up from the Anatolian interior for burial.

Since the signing of the Armistice over 300 personnel of the Navy, Army and Air Force have been buried in the Crimean Cemetery. Of these, two are R.A.M.C. officers, Major H. G. Sherren, a victim of typhus, which he contracted from the Russian refugees he was tending at Prinkipo amidst manifold difficulties, and Captain G. A. Mitchell, who was serving at the General Hospital in Constantinople.

April of this year has seen the newly turned soil over the grave of yet another medical officer. Outside the historic town of San Stefano (where the Peace treaty was signed after the Russo-Turkish War of 1877-78), there is an aerodrome of the Royal Air Force. Typhus was raging in a camp nearby, packed with Christian refugees from the Black Sea ports. The camp was of the usual refugee type to which the Near East is habituated—a concentration of unorganized squalor and intense wretchedness. Flight Lieutenant H. Street, of the Royal Air Force Medical Service, heroically tried to give what assistance he could to the neglected sick, who were living and many dying in distressing conditions. He contracted typhus and died himself after a short illness. He has added one more name to the list of very gallant medical officers who have fallen willing victims to their own self-sacrifice.

It only remains to add that this is not the only cemetery in the neighbourhood of Constantinople where British Crimean dead are buried. Some lie in the burial ground at Kuleli, on the Asiatic shore of the Bosphorus, where the dead from the hospital established in the palace buildings were interred. This has not been maintained with any particular care and is in a decaying condition at present. Others lie buried on the opposite shore at Therapia, the site, during the Crimean War, of a convalescent camp. This description has been confined to the Scutari Cemetery, as it was intended to be the central memorial of the Crimean War, and is the

recognized place of pilgrimage for visitors who wish to see the Crimean graves.

The work for these notes has been done in Turkey in time of crisis, or to be more accurate, successive crises or pseudo-crises. It was originally intended to amplify them by consulting Crimean literature when the fortunes of war, or the beckoning of authority, brought the writer back to a civilized library. As the occupation of Turkey has already been prolonged beyond all unofficial estimates, and the end is not yet in sight, it was thought better not to delay publication, but to explain the circumstances in which the notes were written.

The writer is indebted to Mr. Arthur Baker, a well known local historian, for his advice, and to the present custodian of the cemetery, Mr. W. Lee, who upholds worthily the traditions of his office, for many helpful courtesies.

Colonel Sir Matthew Fell, at whose suggestion these notes were put together, arranged for the illustrations to be drawn by a Russian artist, a refugee in Constantinople.

APPENDIX.

Alexander McGrigor, M.D., Deputy Inspector General of Hospitals.
C. Hume Read, Staff Surgeon.
Alexander Struthers, M.D
Harvey Ludow, F.R.C.S.
James A. Wishart, M.D.
"Surgeons Macauley and Boxall, Acting Assistant Surgeons Sibalds and Coates, of the Anglo-Turkish Contingent."
David Anderson, "Native of Dumfries. Died at Scutari of cholera."
Frederick A. Macartney, Staff Assistant Surgeon.
R. Simmons, Assistant Surgeon.
Edward John Complin, Civil Assistant Surgeon attached to the British Army.
H. W. Wood, Staff Assistant Surgeon.
John Graham, Assistant Surgeon, 71st Regiment.
Edmund Sydney Wason, M.D., Assistant Surgeon 13th Light Infantry, "who died in the Hospital at Scutari while actively and faithfully discharging his arduous professional duties, Feby. 8, 1855."
Doctor Mayne.
Doctor Keitel, German Legion.
Sophia Walford, Matron, Barrack Hospital, Scutari.
Sophia Barnes, Nurse.
Mary Marks, Nurse.
Martha Clough, "died on board the 'Orinco' on her passage from the Crimea to Scutari, 24th September, 1855."
Lucas Ward, Esq., "Purveyor to the Forces, who died at Scutari, 1st of January, 1855, after serving his country for 46 years."
Charles Platt, "Steward of the Harem Hospital."
Dispenser Beveridge.

Current Literature.

Observations on a Bacteriolytic Substance (Lysozyme) found in Secretions and Tissues. By A. Fleming and V. D. Allison. *Brit. Journ. Exper. Pathol.*, 1922, 5, 252.—There exists in human secretions and tissues (with few exceptions), as well as in animal and some vegetable tissues, a powerful bacteriolytic agent, lysozyme. The lytic action of this substance is especially manifested on certain non-pathogenic bacteria, and in all probability it is the cause of such bacteria being non-pathogenic, but it is exerted also on some bacteria which are pathogenic to the lower animals and some which have been isolated from the human body. A large non-pathogenic coccus has been used as an indicator microbe in the investigation of the distribution of lysozyme. It has been found that the lytic substance is present in secretions, especially in tears, nasal mucus, and sputum, and in tissues, especially in cartilage, while it is present in large quantity in white of egg. The properties of lysozyme are detailed. Resistant forms of the indicator coccus are readily developed, and it is found that strains made resistant to one tissue are equally resistant to all tissues, indicating the essential similarity of lysozyme from different sources. Lysozyme is not absorbed by saturation with the test microbe, but on the other hand the lytic power is increased, and the increase is dependent on the number of microbes dissolved. It has not been found possible to transmit the lytic principle in series as can be done with the "bacteriophage," and a consideration of the properties of lysozyme and the bacteriophage makes it clear that there are fundamental differences between them.

Agglutination of Washed Red Blood-corpuscles by Colloidal Silica. By S. L. Cummins. *Brit. Journ. Exper. Pathol.*, 1922, 5, 260.—Colloidal silica solution to which sufficient salt has been added to bring the mixture up to 0·75 per cent of NaCl brings about rapid agglutination of washed red blood-corpuscles, and this result can still be obtained after considerable dilution. The flocculation and sedimentation of washed red cells by colloidal silica as above is to a great extent prevented by the presence of concentrated human serum, this inhibition disappearing as the serum is made more dilute. The inhibition seems to depend upon the formation of a gel.

Treatment of Yaws by Tartar Emetic. C. B. B. Reid, Annual Medical Report, Tanganyika Territory, 1921. Appendix I, p. 54.

Notes on the Treatment of Yaws with Bismutho-sodium and Potassium Tartrate. J. O. Shircore. *Ibid.*, Appendix IV, p. 57.—Reid treated 182 cases with intravenous injections of tartar emetic, the dosage being 1½ grains at from four to seven days' intervals. Intramuscular injection was used in a few cases, and mercury and potassium iodide were

given by mouth daily during treatment. Six patients left hospital without completing treatment, and the remaining 178 were discharged free from all symptoms after an average stay in hospital of thirty-five days, and an average of seven injections each. Two cases were re-admitted, six and eight months later respectively, and forty-two of the remainder have reported periodically for periods ranging from two to nine months, all being free from further symptoms. The author concludes that, while the action of tartar emetic is not to be compared to that of salvarsan in yaws, in the absence of the latter it is a valuable adjunct to mercurial and iodide treatment, the average stay in hospital having been decreased by eighteen days as compared with the records for the previous two years.

After seeing a cutting from the *Times* to the effect that bismutho-sodium and potassium tartrate had given good results in syphilis in the hands of Dr. Roux at Paris, Shircore approached the local chemist, who succeeded in producing a similar salt prepared from bismuth oxide. A quantity of this salt was distributed to medical officers in districts where yaws is prevalent, and a circular issued containing directions and a request for its use in cases of yaws and other spirochætal diseases. Dr. J. H. Parry reported in detail on fourteen cases of yaws, nine of tertiary yaws and syphilis, and nineteen other cases. He considers "that the action of this drug on cases of yaws is remarkable and is in every way as satisfactory as salvarsan." Other medical officers reported equally satisfactory results.

The Relation of Vitamin C to Bacterial Infection. By G. Marshall Finlay. *Journ. Path. and Bact.*, January, 1923, xxvi, No 1, p. 1.—Experiments with vitamin C deficient diet where performed on guinea-pigs with a view to testing the effect on resistance to bacterial infection, the organisms used being pneumococcus, *Staphylococcus aureus*, *Streptococcus hæmolyticus*, and *B. coli*. The results seem to show that guinea-pigs fed on diet deficient in vitamin C succumb to a smaller infecting dose of bacteria than animals fed on a complete diet. Toxæmia occurs more rapidly in scorbutic than in control guinea-pigs, either because the tissues, especially the heart, are most susceptible to the action of bacterial toxin, or because in scorbutic animals there is more toxin formed by the bacteria as a result of some rupture in the defence mechanism of the body. It has long been known that degeneration in the hæmopoietic bone marrow is associated with a reduced resistance to bacterial infection, and such a degeneration is present in scurvy. It, therefore, seems not improbable that the lesion in the bone marrow may be at least one of the factors in reducing the resistance to bacterial infection in scorbutic animals.

Herpetic Meningo-Encephalitis in Rabbits. By C. Da Fano. *Journ. Path. and Bact.*, xxvi, No. 1, January, 1923, p. 85.—The vesicular fluid of all forms of herpes, with the possible exception of zoster, contains a virus by means of which a fatal disease transmissible in series from animal to animal may be caused in susceptible animals. One of the

localizations of the disease is in the central nerve system where an inflammatory condition has been observed characterized by widespread small-celled infiltration, intense nerve cell degeneration, and diffuse proliferative phenomena on the part of some of the fixed elements of the tissue affected. This condition of herpetic meningo-encephalitis has many points of similarity both with the malady known as encephalitis lethargica and with the form caused experimentally in animals with the virus of this disease. Many points of similarity exist between the herpetic and encephalitic virus and both probably belong to the same group of pathogenic agents. It is uncertain whether the virus is filter-passing and whether it may be cultivated on certain media.

Observations on Wild Rats in England with an Account of their Ecto- and Endo-parasites. By Andrew Balfour. *Parasitology,* xiv, No. 3, December, 1922, p. 282.—Attempts were made without success to secure a micro-organism which could induce abortion or sterility in wild rats and which might be used in an anti-rat campaign, more especially when plague threatens the community. An account, however, is given of certain micro-organisms producing pathological conditions in the genito-urinary track of wild rats. A routine determination of rat parasites led to the discovery of a new species of hymenolepis and has shown that *Heligmosomum braziliense* is present in rats in England. *Leptospira icterohæmorrhagiæ* was found to be present in the urine in 13·6 per cent. of 154 brown rats and in the kidneys in 22·6 per cent. The few black rats examined were negative. It was shown that apparently a guinea-pig may act as a carrier of the leptospira without exhibiting any marked symptoms of disease. There is also some evidence to prove that infection may take place through the alimentary track. The leptospira was successfully and easily cultivated in Wenyon's modification of the Noguchi method, but in a large measure loses its virulence as the result of repeated sub-cultures.

Constatations médicales faites au cours de la rééducation physique des hommes du contingent de la classe 1921, a l'école de Joinville. By M. R. Treves. *Ach. Med. Pharm. Militaires,* lxxvii, No. 2, August, 1922, p. 198.—The Joinville School received 314 men of the 1921 class, of whom 266 were found suitable for special training. These were returned to their depots as fit for service, after a period varying from one to six months, with an average of three to eight months. Twenty-one were classed as markedly below normal, 218 as moderately below normal, and 27 as slightly below normal. The defects comprised mainly poor physique, spine curvature, or incomplete function in one or more of the limbs. The men underwent a graduated course of physical training subject to very detailed medical observation, which was directed largely to the duration of tachycardia and dyspnœa after exercise. The weight and spinal curvature where present were watched, and it was found that

in a certain number of individuals the defective condition was due entirely to insufficient nutrition. Increase in height was observed in 138 men.

Head Injuries of War. Benjamin T. Edye, *Med. Journ. of Australia*, January 6, 1923, p. 5.—The author divides head injuries into two groups:—

(1) Those without a wound and therefore uncomplicated by bacterial infection.

(2) Those with a wound and where infection was almost invariably present.

The paper deals mainly with the second group and emphasizes the importance of early operation and the use of X-rays. The most satisfactory results were obtained when the wound was excised, all damaged tissues, skin, bone, meninges or brain, as well as foreign bodies, being removed under local anæsthesia. It is found that the prognosis depends largely on whether the dura mater was torn or not. If the dura is torn, basal infection takes place through the brain substance and the ventricles, but if the dura is intact, infection can only spread locally and is usually shut off early by adhesions. Ninety-one patients in whom the dura mater was intact all recovered, while of 72 patients with laceration of the dura 50 recovered and 29 died, a mortality of 36·7 per cent. All patients who lived two or more days showed evidence of cerebritis or meningitis, the most frequent organism being a streptococcus.

Reviews.

SECOND NOTICE.

OFFICIAL HISTORY OF THE WAR. MEDICAL SERVICES. SURGERY OF THE WAR, VOLUME II. Edited by Major-General Sir W. G. Macpherson, K.C.M.G., C.B., LL.D.; Major-General Sir A. A. Bowlby, K.C.B., K.C.M.G., K.C.V.O.; Major-General Sir Cuthbert Wallace, K.C.M.G., C.B.; and Colonel Sir Crisp English, K.C.M.G. Price £1 5s.

Chapter IX deals with wounds of the joints and is from the pen of Colonel C. H. S. Frankau. It is perhaps the characteristic chapter of this volume, and as a textbook article is purely admirable. The author concerns himself mainly with the treatment of gunshot injuries, and lays down rules first on general principles and then with special reference to individual joints. We have here no bewildering balance between one set of opinions, one line of treatment, and others, but the work might be placed in the hands of the surgeon inexperienced in war surgery with complete confidence that if he followed the advice there given he could not

go wrong. After a short account of the vicissitudes through which in the early days of the war joint wound treatment passed, the general principles of treatment are laid down. The power of the synovia to deal with infections is noted and the necessity of extension to save softened cartilages emphasized. The wounded joint is then carried from the "forward area" to the "base" and the treatment indicated at various stages. In the consideration of the treatment of individual joints the following remarks may be made:—

(1) Hip-joint wounds may travel badly, but the base is nevertheless the place for them as they cannot be efficiently immobilized in abduction anywhere else. The author mentions Jones' abduction frame, but makes no reference to Sinclair's net frame which is by far the best method of treating these cases. Jones' abduction frame is suitable only for travelling and even then usually causes bedsores.

(2) In considering wounds of the knee-joint more perhaps might have been said about Willems' early movements in infected cases, and about the imperative need of facing early the necessity for amputation in cases of persistent suppuration. In the reviewer's experience many deaths, especially in early days, were due to unwillingness to sacrifice a dangerously infected limb in order to save life. Colonel Frankau dismisses the subject in ten lines. It took a couple of years to evolve the proper treatment of knee-joint wounds under the unusual conditions of stabilized siege warefare. The next war may be a war of movement, and there is then likely to be a recapitulation of our earlier experiences. In any case there will be many suppurating knee-joints.

(3) In the treatment of wounds of the ankle-joint and tarsus no mention is made of Sinclair's "serrated" footpiece, a method he used much more frequently and successfully than the one mentioned. It is noteworthy too that Colonel Frankau recommends Syme's amputation as an amputation of choice. All gunshot wounds are not dangerously septic, but all are septic, and there is much to be said against Syme's amputation in septic cases, even when the flap is sutured secondarily as he recommends.

(4) As regards excision of joints, the writer allows removal of the head and neck of the femur, a subperiosteal partial resection of the elbow-joint in severe sepsis, excision of the astragalus in certain ankle-joint cases, but deprecates anything like formal excisions either primary or secondary.

The chapter concludes with a good summary of the treatment of ankylosis of the several joints.

Chapter X deals with gunshot fractures of the upper extremity, and the same general remarks apply to it as to the preceding chapter. It is excellent as a textbook article, deals chiefly with treatment, contains no controversial matter, and makes no reference to what was known before of gunshots of the upper extremity.

Reference is made at the beginning of the chapter to the difficulties of revision of the wound in the forearm. It is in this situation that irre-

mediable mutilation has been inflicted with the best intentions, chiefly owing to the number and size of the nerve trunks. Colonel Frankau also advises free removal of bone fragments from a shattered humerus, pointing out how little difference to function a shortened humerus makes. This would have been a good opportunity to mention Leriche's conclusions as regards subperiosteal esquillectomy, which certainly deserved comment, even if it conveyed condemnation.

The evolution of splinting during the progress of the campaign is very well indicated. There is nothing which needs special comment in the body of the chapter.

Chapter XI on fractures of the lower extremity is from the capable pen of Colonel A. E. Webb Johnson. He also concerns himself mainly with the methods of treatment evolved during the war, and of the forty pages of the chapter all but the last three or four are allotted to consideration of gunshots of the femur. Considering the mortality, amputation rate, and invalidity due to this formidable injury, the proportion is perhaps not unnatural, but we cannot help thinking that rather more might have been said about gunshots of the leg, injuries which were responsible for an immense amount of invalidity, and according to Sir George Makins, even in the South African War "possessed an unenviable degree of importance." It is noteworthy that attention is drawn to the possibility of non-union in fractures of the tibia. It used to be taught that the humerus was the typical bone in which non-union occurred, but this is certainly not the case in gunshot injury. In describing methods of extension in the case of fractures of the leg low down, Finochietto's stirrup and Besley's callipers are mentioned. No details of application are given for the latter, and it was surely found in the course of the campaign that the former was a very undesirable instrument, and one liable to be associated with all sorts of complications.

Some sensible advice is given in the last section on wounds of tarsus and metatarsus which may be summed up as follows :—

(1) It is of little use to spend time and ingenuity in saving a foot which will not bear the weight of the body.

(2) Amputations through the foot are bad.

(3) Preserve the sole intact in making incisions.

The account of femoral injuries begins with a contrast of the failure of early methods of treatment with the condition of things in the last year of the war. It is well pointed out that the improvement was not entirely due to the adoption of the Thomas splint, nor to the recognition of the need for special hospitals, and a unified and continuous method from front to base. Actually, says Colonel Webb Johnson, no type of wound benefited more than did the fractured femur from the advance that was made in the general treatment of war wounds.

Methods of treatment for the front line, the casualty clearing station and the base are then indicated, and suggest the following remarks :—

(1) Fixing the foot by bandages applied over the boot was an advance, but almost better was the skewer thrust through the boot above the sole which was used by Sinclair.

(2) Leriche's methods are done full justice in the account of bone removal at the casualty clearing station. Few surgeons, even when they realized what he really meant by the subperiosteal resection of loose fragments, had the time, skill or patience to carry out his methods.

(3) The writer records the complete failure of the Carrel treatment during transport. Even at base hospitals it is hardly a war treatment. Each dressing demands the aseptic precautions of an operative procedure, and makes too many demands upon staff and material.

(4) To the end of the war the reviewer met with surgeons to whom the differences between weight extension, fixed extension, extension by suspension, counter extension, and so on, were far from clear. It may be said that they ought not to have had fractures to treat, but there was often little choice of men. And it is a fact that the really mechanical mind is rare, while manipulative skill in other branches of surgery may not be so rare. So that in addition to the difficulties of severe infection, there was superadded in many cases inadequate knowledge of the mechanical treatment of this most difficult bone. That the late results were as good as they were is one of the surgical wonders of the war. Nevertheless there are plenty of the earlier cases to damp our self congratulation.

Chapter XII deals with the Organization of Military Orthopædic Centres, with Massage and with Remedial Exercises, and is by Captain McCrae Aitken, Mr. J. B. Mennell and Surgeon-Commander Murray Levick.

As is remarked in the Preface, this is probably the first occasion on which work of this kind has been undertaken by the Army Medical Authorities in connexion with British campaigns. It is work which has not only to do with material things, such as the repair of nerve injury and bone destruction, but also enters boldly into the uncharted region where thought is transferred into action, a region which from its very indefiniteness has so often been the chosen ground of the crank and the charlatan. Nobody who has enjoyed the pleasure of listening to a lecture on the psychology of drill by Colonel R. B. Campbell can doubt that a therapeutic, based largely on the English love of competition in games, has been instrumental in restoring function in hundreds of cases upon which ordinary methods have been lavished in vain. The co-operation of the patient himself is enlisted in the work of restoration. The surgeon is no longer remote and majesterial, but an observant and stimulating playmate.

Captain McCrae Aitken gives a brief outline of the constitution of an orthopædic centre, and the classification and treatment of patients. He shows how a patient's interest in his case is aroused, how important is correct preliminary treatment, reviews the evolution of orthopædic hospitals throughout the kingdom and emphasizes the need for similar centres in time of peace.

Mr. Mennell traces the history of the Military Massage Corps from its inception by Mr. and Mrs. Almeric Paget to the grant of its charter on June 9, 1920. He shows that encouragement of voluntary effort on the part of the patient and the re-education of lost co-ordination are important aids in the restoration of function and quotes Colin McKenzie's work on muscle action and the aid which may be given by gravity in assisting the restoration of muscular movement.

In the final section Surgeon-Commander Murray Levick writes on physical training. He thinks all efficient systems are based upon the principles laid down by Ling, and gives an account of the school of physiotherapy at St. Thomas's Hospital, with the apparatus necessary for proper treatment. He also mentions the work at the Liverpool Pensions Hospital, the Shropshire Surgical Home and the Edmonton Hospital. He says that much remains to be learnt on the psychical side of remedial exercises and finds that as usual personality counts for more than methods. His account of convalescent camps, though short, is of great interest. These units have taken a definite place in the treatment of the wounded soldier in a long campaign.

America has always taken an interest in orthopædics and was able during the war to lend valuable aid to Great Britain by sending trained surgeons.

At the end of 1919 it was found that most of the cases under treatment in orthopædic hospitals were wounded in the earlier years of the war and had not had the advantage of early orthopædic treatment. This significant fact shows how necessary it is to provide treatment for the wounded soldier until he can be returned to civil life with the highest possible industrial or working value.

The next two chapters XIII, XIV, summarize the surgical after-treatment of war injuries to the limbs. They are written by such well known surgeons as Sir Robert Jones, Mr. Hey Groves and Mr. Elmslie, and retell in somewhat condensed form the story which is told in the "Orthopædic Surgery of Injuries" recently reviewed in these columns. In those volumes will be found, adequately illustrated and detailed at length, the application of orthopædic principles to war wounds, incorporating all the lessons learnt in the war. There is the less reason therefore for discussing them at length here. What is new has been laid down and for the most part accepted. The subject of orthopædics, confined to a narrow circle of surgeons before the war and dealing with a limited class of case, has been seriously considered by some of the best brains in the surgical profession and has therefore shown a notable accession of interest and consideration by the medical public. The true principles of preventive and curative treatment have been formulated, and new methods and even a new nomenclature have been evolved.

The subjects considered here are Tendon Transplantation, Stiff, Ankylosed and Flail Joints, and Ununited Fractures. In the last section copious

illustrations appear, and a bibliography, which is wanting in the two previous sections.

On p. 413, line 13 from the bottom, "tibia" should be "femur." On p. 424, line 7 from the top, "upwards" should be "downwards" and in line 13 the word "extended" should surely more correctly be "dorsi-flexed."

In the chapter on Amputations and Artificial limbs it is rightly pointed out that the number of amputations seen in civil surgery is small and that no attention is given in textbooks to the kind of stump to be desired, or to the fitting of an artificial limb. The author therefore takes up these points seriatim for upper and lower limbs. There is much which certainly never appears in ordinary surgical textbooks, and much which would be unnecessary in them. But at least the reaction upon amputation methods of recent war experience should find a place in them for the future. An interesting section ends with a description of temporary artificial limbs.

Chapter XV begins with a section on the organization of the ophthalmic department in which the author shows a well justified pride in the perfection of arrangements for treatment, for evacuation of eye cases, and for the supply of spectacles. Normally for a small Army like ours it is enough to insist that the recruit shall have "moderate but adequate vision." For a nation in arms, however, standards of vision must necessarily be lowered and this means spectacles supply. Concussion injuries and wounds are next dealt with and a description of the magnet used to extract foreign bodies is given. The illustration on p. 523 is not very clear. Diseases both functional and organic are next considered, followed by an interesting account of the injuries due to mustard gas. This is well illustrated by some of Serjeant A. M. Maxwell's paintings. The chapter then ends with a short account of ophthalmic work in Egypt, referring specially to anticipations regarding tracheoma which was a scourge of the Napoleonic armies in 1799-1801, and in Macedonia with special reference to the ocular disabilities resulting from malarial infection.

In the chapter dealing with war injuries to the ear, Mr. Sydney Scott points out that invalidity due to loss of hearing occurred more frequently in the Great War than in any previous campaign. He probably has good reasons for this observation, but it must be one which is difficult to establish, though campaigns from 1864 to 1905 are quoted. Some remarks on examinations of recruits and the establishment of aural centres follow, and then the remainder of the chapter is devoted to a description of battle injuries, including tympanic ruptures due to shell bursts (the risk of indiscriminate syringing in these cases is insisted upon) and nerve deafness, the association of which with general neurasthenic conditions is emphasized. The section ends with a few paragraphs on the pathological conditions found to be associated with deafness of this type. On p. 574, line 5, the word "facial" should surely be "cochlear."

It remains only to make some reference to the printing, paper and binding of these volumes. The use of two kinds of paper was no doubt

intended to facilitate the reproduction of illustrations, but it detracts in our opinion from the appearance of the volume. Illustrations are for the most part fairly dealt with, but the process of diminution has in some cases reduced the lettering and numerals below comfortable visibility. Reading has been carefully done. A few errors have been pointed out, but they are commendably few. The binding is adequate, if no more. While therefore we are not inclined to alter our opinion expressed at the beginning of this review that the surgery of the war is hardly done full justice in these volumes it may perhaps be said that much in them is of high value as an instalment.

ROYAL ARMY MEDICAL CORPS AT HOME AND DINNER, 1923.

The Annual Dinner of the Corps has for many years afforded officers the opportunity of reviving old friendships; but until this year the ladies of the Corps have not been considered, and it was felt that the day of the Annual Dinner, June 18 would be a favourable opportunity to inaugurate at the Royal Army Medical Corps College Mess, an At Home for serving and retired officers of the Corps, their wives, families and friends, and members of Queen Alexandra's Imperial Military Nursing Service.

Despite unpleasant weather there was happily a large gathering, and the guests numbering fully 250 were received by Sir John and Lady Goodwin. Tea and refreshments were served in the Mess and Smoking-rooms which were suitably decorated for the occasion, and the string band of the Corps under the able direction of Mr. Lane rendered an admirable programme of music and delighted everyone with the excellence of their playing. The Corps is indeed to be congratulated on the possession of a band of such high merit. There can be no doubt as to the success of our first At Home held in connection with the Annual Dinner, and it is to be hoped it will become an established feature in the social life of the Corps.

The Annual Dinner was subsequently held at the Trocadero Restaurant at 8 p.m., the Director-General in the Chair. Sir Vesey Holt, K.B.E., was the only guest. Dinner was served for 173.

The following officers were present:—

Lieutenant-Generals.—Sir John Goodwin, Sir W. Launcelotte Gubbins, Sir A. T. Sloggett.

Major-Generals.—W. W. O. Beveridge, Sir G. D. Bourke, H. Carr, Sir William Donovan, W. J. Fawcett, Sir T. J. Gallwey, T. W. Gibbard, S. Guise Moores, Sir S. Hickson, H. A. Hinge, W. W. Kenny, Sir W. B. Leishman, Sir W. G. Macpherson, J. R. McMunn, Sir J. Maher, Sir F. R. Newland, Sir T. J. O'Donnell, Sir M. W. O'Keeffe, E. M. Pilcher, C. E. Pollock, Sir M. W. Russell, Sir G. B. Stanistreet, A. A. Sutton, Sir H. R. Whitehead, Sir T. Yarr.

Colonels.—H. P. Barrow, E. T. F. Birrell, A. W. N. Bowen, J. S. Bostock, S. L. Cummins, H. E. M. Douglas, H. N. Dunn, C. R. Evans, P. Evans, H. B. Fawcus, E. C. Freeman, C. Garner, H. W. Grattan, W. L. Gray, S. F. St. D. Green, W. R. P. Goodwin, R. S. Hannay, L. W. Harrison, E. T. Inkson, H. E. R. James, R. Jennings, J. C. Kennedy, R. Kirkpatrick, H. T. Knaggs, C. B. Martin, T. C. Mackenzie, R. L. R. Macleod, G. A. Moore, C. K. Morgan, H. W. Murray, L. T. M. Nash, G. T. Rawnsley, F. Smith, A. E. Tate, G. St. C. Thom, D. Wardrop, Sir A. L. A. Webb, J. W. West, R. J. Windle, Sir E. S. Worthington.

Lieutenant-Colonels.—R. B. Ainsworth, J. G. Bell, R. P. Bond, S. Boylan-Smith, W. Benson, T. S. Coates, A. B. Cottell, J. M. H. Conway, V. J. Crawford, G. G. Delap, N. E. Dunkerton, J. A. Gormley, A. E. Hamerton, E. C. Hayes, P. Henderson, H. C. R. Hime, W. Hooper Pinches, J. Mackenzie, J. F. Martin, C. D. Myles, F. P. Nichols, W. W. Pope, R. L. Popham, J. J. W. Prescott, N. J. C. Rutherford, E. P. Sewell, J. B. Short, W. M. B. Sparkes, W. C. Smales, H. G. F. Stallard, A. D. Waring, W. J. Waters, J. F. Whelan, H. L. E. White, G. Wilson, A. Wright, W. B. Winkfield, B. F. Wingate.

Majors.—W. Bissett, D. S. Buist, F. A. H. Clarke, R. J. Cahill, J. A. Clark, K. Comyn, O. C. P. Cooke, V. H. W. Davoren, R. M. Davies, W. Davis, M. G. Dill, N. Dunbar Walker, H. R. Edwards, W. Egan, T. Exton, P. C. T. Davy, H. H. J. Fawcett, A. N. Fraser, W. L. E. Fretz, A. T. Frost, J. K. Gaunt, F. J. Garland, J. Gilmore, D. L. Harding,

H. C. Hildreth, M. P. Leahy, W. E. Marshall, C. McQueen, O. W. McSheehy, A. A. Meaden, T. J. Mitchell, D. B. McGrigor, W. H. O'Riordan, H. W. Russell, E. M. Pennefather, E. T. Potts, P. S. Stewart, E. A. Sutton, R. E. Todd, G. Wilson, G. S. Wallace, T. A. Weston, R. C. Wilmot, J. M. Weddell, J. R. Yourell.

Captains.—E. B. Allnutt, F. C. Atkinson-Fleming, E. A. P. Brock, E. C. Beddows, G. T. Baker, T. P. Buist, D. G. Cheyne, C. L. Emmerson, R. S. Dickie, J. C. A. Dowse, C. R. Dudgeon, W. Foot, J. S. B. Forbes, F. P. Freeman, F. M. Lipscomb, J. P. Macnamara, D. C. Monro, P. A. Opie, T. V. Oldham, E. Phillips, R. H. C. Pryn, E. O. A. Singer, H. M. Sealy, T. R. Snelling, R. R. Thompson, W. E. Tyndall, J. G. Wells, C. Wilson.

During dinner the following programme of music was performed by the Corps' band under the direction of Mr. Lane, Bandmaster, R.A.M.C.

1. Grand Ballet Egyptien	*Luigini*
2. Three Hungarian Dances	*Brahms*
3. Selection—"The Gondoliers"	*Sullivan*
4. "Valse des Fleurs"	*Tschaikowsky*
5. "Air de Ballet"	.. *Pitt*
"Valse Triste"	*Sibelius*
6. Miniature Suite	*Eric Coates*
7. Three Bavarian Dances	.. *Elgar*
8. Russian Boatmen's Song	*Traditional*

"God save the King."

After the usual loyal toasts had been honoured, Lieutenant-General Sir Arthur Sloggett, in proposing the toast of Sir John Goodwin, the retiring Director-General, said:—

"Brother Officers, as perhaps you know, it is not our custom at these dinners to have any speeches except the usual loyal toast to His Majesty the King, but there is one occasion on which we break our rule, and that is at the last dinner a Director-General presides over before he retires, when it is customary to drink his health and wish him God speed. As Sir John Goodwin is shortly giving up the Chair I want you to join with me in wishing him Good-bye, Good luck and every happiness in his future serene and peaceful life, free from the cares of troublesome office, querulous officers and great responsibilities. For over five years Sir John has held the position of Director-General and I can safely say that no one has ever more worthily filled that high office. I will say nothing of my own personal affection for him; for I know him well, he was with me in France, and wherever he served he was universally beloved; and he carried with him to the War Office the reputation he had always borne in the service, that of a white man through and through, as straight as a gun-barrel and in every way a real sportsman. It is too late in the evening, Gentlemen, and we are all too full of good cheer for me to indulge in a long funeral oration over the body of an almost defunct Director-General, but before we drink his health with musical honours I would also ask you to welcome the man who succeeds him, another dear old friend of mine, I mean Sir William Leishman. I feel the Corps is singularly fortunate in having such a charming personality and such a world-renowned scientist as its new Chief. Gentlemen, I give you the toast of long life and all good luck and happiness to Sir John Goodwin, who may be certain he will always be borne in affectionate remembrance by us all, and we hope to see him for many years at our dinners, sitting among the other aged and decrepit ex-Director-Generals (of whom I have the honour to be one) at this exalted and somewhat solemn table, and a hearty welcome to his successor, Sir William Leishman, whom we are proud to have as the new head of an old Corps."

"The Health of Sir John Goodwin" was then drank with musical honours, and most sincere expressions for his future welfare from all the company.

Sir John, in replying to the toast, said:—

"Brother Officers, until a few minutes ago I had never heard of the long-standing custom regarding speeches of which Sir Arthur Sloggett has just told us. Consequently he has caught me unawares and unprepared, and I am afraid that you must suffer in consequence.

"When I assumed office I was heavily handicapped in that I succeeded Sir Arthur Sloggett; my reputation will also be heavily penalized in that I am to be succeeded by Sir William Leishman. Life at the War Office is not an unmixed blessing—it exacts many penalties and has not very many compensating advantages. The life is—or for the last five years has been—rather like that of a galley slave, but now that it is over, one can say with Kipling's galley slave:—

"'And to-day I leave the galley and another takes my place,
So to-day I leave the galley—shall I curse her service, then?
God be thanked—whate'er comes after,
I have lived and toiled with *men*.'

"And so, looking back on the past five-and-a-half years, I regard as the greatest compensation the privilege of having worked with men such as those of whom my staff was composed. Whatever mistakes have occurred, whatever errors of omission or commission, place the blame for them on my shoulders, mine is the responsibility and mine must be the blame. My staff have had a hard time, but they have been loyal and untiring beyond all praise. Gentlemen, if you happen to know of any particular officer who is popular with everyone, who has been successful to an extraordinary degree, to whom fickle Dame Fortune appears to have given of her best with both hands, and should you in your wisdom think that he has had more than his share of praise and popularity, and that some correction is needed, then in such case I can think of no more efficient and salutary—though possibly unpleasant—tonic than a tour of office in 'A.M.D. 1.'

"This is my official good-bye; I thank you most sincerely for all the support you have given me—support without which I could not have carried on—I thank you from my heart for the reception you have given me this evening, and as my final word I tell you that I hand over the reins of office to my successor with a light heart and happy confidence."

Sir William Leishman, in response to hearty manifestations of goodwill from all present, said:—

"I am deeply sensible of the high honour which has fallen to me in my nomination as the successor of Sir John Goodwin. If I can claim any special qualification for the post it lies in my deep affection and respect for the Corps in which I have passed my life.

"I have received a number of friendly greetings on my nomination which were ominously qualified by allusions to the grave nature of the trouble and anxieties which await me, but I take some comfort from the fact that, at the table at which I have the honour to be placed, there are instances which show that the conscientious discharge of the trust is not invariably fatal.

"It has been my privilege to know personally a large number of those present, through our mutual association at the College, and, where my own memories have been at fault, I am deeply indebted to Sir John for filling up many of the blanks. I mention this in order to say that our conjoint labour has led me to two clear conclusions. First, of the Officers about my own standing the great majority appear to me far better qualified than myself to be Director-General. Second, among the more junior ranks, the potential D.-G.'s appear so numerous that I do not envy the task of future Secretaries of State in making choice among them.

"I regard myself as extraordinarily fortunate in having so long notice of my appointment, as this has enabled me to benefit from Sir John Goodwin's experience and advice, and I can find no words warm enough to acknowledge the depth of the obligation which I owe in this, and many other respects, to our present Chief.

"I thank my brother officers most warmly for their expression of good-will, which does much to hearten me for the task which lies ahead."

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

VOLUME XLI. AUGUST, 1923. No. 2.

Journal

of the

Royal Army Medical Corps.

Original Communications.

TICK PARALYSIS.

BY BREVET LIEUTENANT-COLONEL W. P. MACARTHUR.
Royal Army Medical Corps.

RECENTLY Dr. Herbert French received from Dr. A. C. Nash, British Columbia, a very interesting account of several cases of paralysis attributed to tick bites. He also sent several specimens of ticks, stating that "the cases seemed to be traceable to the bites of these." The ticks were forwarded to the Royal Army Medical College for identification, where they were found to be *Dermacentor venustus* Banks, six gorged ♀ ♀ and one ♂. As is well known, this is the species also incriminated in the spread of spotted fever of the Rocky Mountains.

Dr. French suggests that parts of Dr. Nash's informative communication should be published, together with some account of the interesting condition known as tick paralysis.

Dr. Nash says, "These wood-ticks live on the sage brush with which all our uncultivated lands are covered. . . Sheep and dogs are stated to be paralysed and frequently killed by them. . . With regard to attacking human beings : They get on the clothes or body of anyone in or near the sage-brush, and usually work their way to the head or neck, often being found actually in amongst the hairs of the scalp with 'nose' buried deep in the scalp, or else on the nape of the neck.

"An essential oil or a hot needle applied to the 'insect' is said to make him loosen his hold, but if deeply embedded nothing short of cutting him out is of any use ; for should he be pulled off and the 'head' left in the wound a sore spot will be left which may take many months to heal. I prefer to raise the skin into a tent by slight traction and to snip with the scissors clear of the 'head.'

"The bite of these 'insects' is never felt, and the question has been raised whether their poison has an anæsthetic action. The tickling of the legs often warns a person that one is on him, but so far I have been unable to find anyone who has felt the actual bite. The site chosen by the 'insect' is, of course, thick and poorly innervated skin, which might partly account for this.

"I was called to see a child last summer who died in less than forty-eight hours, and after death two wood-ticks were found on the back of the head. I did not see the child alive, but understand that she complained of thirst and increasing difficulty in breathing. I did not make a post-mortem.

"Another child died at Clinton suddenly a few years ago and after death a wood-tick was found just after it had released its hold. The bite was in the hollow of the neck and just below the back of the head.

"Last year a child six miles from here was getting drowsy and paralysed and the parents started to bring the child to me. On their way they found a wood-tick on the child's neck and after its removal the child rapidly recovered.

"A man was in hospital in a small town near here suffering from paralysis of the legs from no apparent cause. The matron eventually found a wood-tick embedded in the skin of one groin and after its removal the patient rapidly recovered.

"These facts sufficiently indicate the dangerous nature of the bites of these 'insects,' especially on children and anywhere round the head and neck . . . At present we are completely in the dark, and unless the cause of the drowsiness is found sufficiently early, the little patients seem to die."

Dr. Nash does not say definitely if any of the ticks sent were removed from the paralysed cases. Even if they were not, it is highly suggestive that *D. venustus* is found commonly in the locality where these cases occurred.

The first cases of tick paralysis recorded from Canada appear to be those collected by Todd (1), of McGill University. During an inquiry regarding the possible occurrence of spotted fever in British Columbia, he circularized practitioners asking for an account of any cases of disease attributed to tick bites. Several cases of paralysis were reported, some of which had proved fatal. Paresis and paralysis of the legs were the most constant symptoms. In most instances the ticks were found near the nape of the neck. In some, the symptoms ended in death due to involvement of the respiratory muscles; in others, after removal of the ticks complete recovery followed in a few days. One doctor reported an interesting series. The first case died suddenly with symptoms of acute ascending paralysis. After death a large tick was found at the nape of the neck. A second child with the same symptoms died after an illness of two days. A tick was found attached to the right temple. This experience suggested the presence of a tick when a third child was seen suffering from

an ascending paralysis of two days' duration. One was found at the nape of the neck; it was removed and in two days the child was quite well again. Later a little girl became ill with complete paralysis of the lower limbs and marked paresis of the arms. Three ticks were removed from the neck and the child recovered completely. It does not appear that the species of tick implicated in these records was determined. Seemingly they were assumed to be *D. venustus*, as this species is common in the district affected.

Hadwen (2) reported a similar disease affecting sheep in British Columbia. From 1910-13 he had received complaints from a sheep farmer regarding a form of paralysis occurring in his flocks. Hadwen thought that the disease might be the same as that reported by Todd, and on investigation he found that the sheep were infested with *D. venustus*. He produced the disease experimentally in lambs by allowing these ticks to feed on them. Paralysis occurred six or seven days after the ticks were put on. He points out that only the adults of *D. venustus* attack man and the larger animals. The females take four to ten days to feed and drop off. If the ticks are removed early no pathogenic effects follow the bite.

Hadwen suggests that the paralysis may be due to toxins formed in largest amount when gorging is most active, i.e., about twenty-four hours before the ticks drop off. He failed to transmit the disease by inoculating blood, emulsions of brain, spinal cord, and crushed ticks which had caused paralysis. All cultures were negative. The only pathological lesions found in the animals were hæmorrhages at the site of the bite, and congestion of the brain and cord.

Hadwen's experimental results were confirmed by Nuttall [3] in Cambridge. One *D. venustus* ♀ sent from Canada was allowed to gorge on a dog which developed paralysis of the legs and incontinence of urine, the symptoms appearing on the ninth day of attachment. The animal made a complete recovery. Nothing abnormal could be found in its blood.

In the Western United States paralysis in man associated with tick bites was noted by McCornack [4] as early as 1903. He has published thirteen cases with the same symptomatology as that mentioned above. In one of these the tick responsible is described as "resembling" *D. venustus*. Removed alive, it "attached itself to a guinea-pig, and on the sixth day moderate fever and decreased capacity to use the hind legs were observed." Seemingly in the remainder of the cases no identification of the ticks was attempted.

Temple recorded thirteen cases of tick paralysis in Oregon. I have not seen the original publication, but Nuttall [5] quotes it extensively, and the same cases are also mentioned by Bishopp and King [6]. One of Temple's series shows how readily a tick may be overlooked. Symptoms described to him by telephone seemed so suggestive of tick paralysis that he advised the patient's mother to look for a tick. She informed him later that no tick could be found. He visited the child, who was paralysed and unable to

stand, and after a careful search he discovered a tick hidden in the hair. The tick was removed and the child made a rapid recovery. Temple notes, "There is a great variety of ticks infesting our western slope." Three specimens sent by him for identification—but apparently not collected from any of his cases—proved to be *Dermacentor albipictus*, *D. venustus* and *Ornithodorus megnini* respectively. It is significant that the one species definitely incriminated in tick paralysis occurs in Temple's locality.

Cleland [7] in Australia quotes two cases of tick paralysis, one fatal in two days in which the legs and respiratory muscles were affected. "The tick was almost certainly *Ixodes holocyclus*." In the other, there was muscular weakness and amblyopia. The species of tick responsible is not mentioned. He summarizes observations on about a hundred cases of paralysis in dogs.

A detailed description is given by Eaton [8] of tick paralysis with fever, delirium and diarrhœa in a child in Brisbane. The involvement of the limbs resembled that observed in the American cases, but in addition there were ptosis and paralysis of accommodation. The tick had been removed before Eaton examined the patient, but from a relative's description he thought it was an *Ixodes* of doubtful species. This is obviously an unsatisfactory method of identification, though the only one possible under the circumstances.

Strickland [9] quotes another case of apparent tick paralysis in Australia as described by the patient's mother. The boy complained first of feeling sick and giddy, and was supposed to have a "bilious attack." Three days later, "all his muscles seemed to be affected, he could not walk without assistance, and his face was quite crooked on one side." A tick, discovered by chance, was removed from the ear, and within ten days the boy had completely recovered. Unfortunately the tick was not kept for identification.

The Cape Colony sheep paralysis is attributed to *Ixodes pilosus*, and measures directed against these ticks are reported to prevent the disease. So far as I know, there are no African records of tick paralysis in man, though Sant Anna [10], Nuttall [11] and others have reported instances of tick bite causing fever, malaise and enlarged glands. The ticks inculpated were a species of *Amblyomma*, *Rhipicephalus*, and *Boophilus*.

Various biting arthropods may cause somewhat similar, though usually milder symptoms in susceptible persons. The writer had an interesting demonstration of varying degrees of individual susceptibility to the bite of the same species of arthropod when engaged in rearing *Cimex lectularius*—the European bed-bug—some time ago. He shared the feeding of these insects with two laboratory attendants, both men of a good class who denied any previous personal acquaintance with bugs. One of them was not troubled by the bites either at the time of feeding or afterwards. The second developed an urticarial patch at the site of the punctures, but within a day all inflammation had subsided. The writer felt little effect from the bites for about twenty-four hours, when a severe reaction occurred with

much swelling, reaching a maximum about forty-eight hours after the bite.

If several *Cimex* had been fed simultaneously, the arm became œdematous from the fingers to the shoulder, the axillary glands became enlarged and tender, and there was some fever. Attempts to produce an immunity by feeding at intervals failed, and no perceptible diminution in the reaction occurred within several months. Finally, the feeding of *Cimex* had to be left to others better endowed for the performance of this base mechanic exercise.

General constitutional disturbance with fever, aching pains, etc., may be caused in non-immune persons who become rapidly and heavily infested with *Pediculus humanus corporis*, the symptoms disappearing when the individual is efficiently loused. Such reactions have been produced experimentally by Moore [12] and Hirschfelder [13]. The writer has seen several cases where similar effects appeared to be attributable to an unaccustomed infestation with a swarm of fleas; in one instance a second exposure was followed by a recurrence of the symptoms. Some such reaction may possibly have been noticed popularly in the Middle Ages, for when Chaucer's Cook of Londoun is discovered in a lamentable state of prostration—later to be lifted with "greet showvying" and "muchel care and wo"—the good-natured host suggests infestation with fleas[1] as one of the alternatives to the obviously correct diagnosis of acute alcoholism!

Such symptoms as may follow insect bites under certain conditions resemble generally the effects noted in the African cases of tick-bite mentioned above, except for the usually more severe nature of the latter. Turner, cited by Nuttall [11], records that five men with fever, dirty tongue, and enlarged glands due to tick-bites were quarantined at an African port as suspected plague. This greater constitutional and local disturbance may be due to the ixodine ticks' lengthy period of feeding, and possibly also to the formidable mouth armature of ticks as compared with that of most biting insects. This "tick-bite fever," although a very interesting condition, has no connexion with tick paralysis.

Summary and Conclusions.

Tick paralysis is a definite morbid entity. Under certain undetermined conditions it can be induced by the bite of, at least, *Dermacentor venustus*, as has been established by Hadwen and Nuttall. The reported cases of tick paralysis occurring beyond the range of *D. venustus* appear very suggestive, but experimental evidence definitely inculpating the ticks is lacking.

The symptoms noted are those of an acute, flaccid ascending motor paralysis, without sensory changes. Usually commencing in the legs, the

---

[1] "Hastow had fleen all nyght, or artow dronke . . .
So that thou mayst nat holden up thyn heed?"

paralysis in severe cases also involves the muscles of the trunk, arms, head and neck, with interference with speech and deglutition. In milder cases the patient may appear quite well except that his legs double under him when he attempts to stand. The disease is usually afebrile, but in some cases a rise of temperature has been recorded.

Prognosis is favourable if the tick is removed before the muscles of respiration are seriously involved, and improvement is usually rapid. Most of the published cases have occurred in children, but adults are not exempt from attack.

Whether these symptoms are of infective or of toxic origin is unknown. The negative results of cultures and inoculations, and the prolonged period of attachment necessary to induce paralysis, favour the latter suggestion but are not conclusive. Nuttall and Hindle (14) have shown that East Coast Fever cannot be communicated by the inoculation of even seven litres of blood infected with *Theileria parva,* nor can infected *Rhipicephalus appendiculatus* transmit the disease during the first two days of attachment.

Tick paralysis in North America must have existed unrecognized for years, and a similar diagnostic confusion may possibly obtain elsewhere. Certainly some medical men specifically questioned can recollect cases of obscure and undetermined origin encountered in various tropical countries which might conceivably have been some form of tick paralysis, or where this possibility at least might have been considered. Obviously the presence of ticks on a paralysed person may have no significance whatsoever, but such a coincidence requires careful investigation, including experimental work if possible.

This paper has been compiled at Dr. French's suggestion in the hope of directing attention to a disease which, if sought, will probably be found more widely distributed than is apparent at present, and also to place Dr. Nash's interesting cases on record.

REFERENCES.

[1] Todd. *Canadian Med. Assoc. Journ.*, ii, 686 and 1118 (1912).
[2] Hadwen. *Parasit.*, vi, 283 (1913).
[3] Hadwen and Nuttall. *Parasit.*, vi, 298 (1913).
[4] McCornack. *Journ. Amer. Med. Assoc.*, lxxvii, 260 (1921).
[5] Nuttall. *Parasit.*, vii, 95 (1914).
[6] Bishopp and King. *Journ. Econ. Entomol.*, vi, 200 (1913).
[7] Cleland. *Australian Med. Gaz.*, xxxii, 295 (1912).
[8] Eaton. *Australian Med. Gaz.*, xxxiii, 391 (1913).
[9] Strickland. *Parasit.*, vii, 379 (1915).
[10] Sant' Anna. *Parasit.*, iv, 87 (1911).
[11] Nuttall. *Parasit.*, iv, 89 (1911).
[12] Moore. *Journ. Amer. Med. Assoc.*, lxxi, 1481 (1918).
[13] Moore and Hirschfelder. *Arch. Intern. Med.*, xxiii, 419 (1919).
[14] Nuttall and Hindle. *Parasitol.*, vi, 321 (1913).

ARMY HYGIENE ADVISORY COMMITTEE REPORT No. 3.

On the Maximum Load to be Carried by the Soldier.

By Professor E. P. CATHCART, F.R.S.
Captain D. T. RICHARDSON, M.C.
Royal Army Medical Corps.
and
Captain W. CAMPBELL
Royal Army Medical Corps.

From the Physiology Institute, University of Glasgow.

(*Continued from p.* 24.)

(3) *Varying Length of Pace.*

Another factor which is of considerable importance and one which is, as a rule, practically neglected, is the length of stride. It is of course obvious that if marching by a body of troops is to be carried out with cohesion a uniform pace must be insisted upon and this, in spite of the fact that the men who compose the column have a great natural variation in their normal free-walking length of stride. Men for picked battalions are often selected for uniform height because they look well on parade, and yet if a good marching battalion was required uniformity in length of leg would be infinitely more important.

In the tests which we carried out the rate of progression was kept uniform at 91·44 metres (100 yards) per minute, but the length of the stride varied. The normal average length of stride was determined by frequent observations during the earlier experimental marches and based on this a longer and a shorter stride was selected for each subject.

	Richardson		Campbell	
	Length of pace	Paces per 100 yds. approx.	Length of pace	Paces per 100 yds. approx.
Normal ..	32·7 in. 83·1 cm. ..	111	31·7 in. 80·5 cm. ..	112
Long ..	36·0 in. 91·4 cm. ..	100	35·0 in. 88·8 cm. ..	102
Short ..	29·4 in. 74·7 cm. ..	122	28·4 in. 72·1 cm. ..	127

Each march was of, at least, an hour's duration and three samples of expired air were collected during the period. Results given are the average of the three samples.

During these marches the three loads (35 per cent, 40 per cent, and 45 per cent) of the body weight were tested. The normal march data, used in the Tables IX, X and XI, were taken from the previous experimental

marches on the influence of velocity of marching. Here again the figures have been arranged under varying loads, Table XI, and varying length of stride, Tables IX and X. The consideration of the data given in these tables allows some very interesting deductions to be made. It would appear in the first place, speaking in terms of the length of stride in relation to the varying loads, that with the normal pace the lowest cost is again reached with the forty per cent load. When the long stride is considered it will be noted that the cost increases as the load increases, i.e., the lowest value is reached with the thirty-five per cent load. A similar result is

TABLE IX.—VARYING LENGTH OF PACE; RATE CONSTANT. RICHARDSON.

	Normal pace			Long pace			Short pace		
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation, litres per minute	17·59	18·00	18·72	20·11	19·34	20·75	17·95	19·83	20·30
Oxygen intake in c.c. per minute	994	947	1·063	870	1,076	1,195	906	960	994
Calories per minute	4·797	4·620	5·189	4·206	5·176	5·765	4·364	4·646	4·809
Calories per square metre per minute	2·590	2·497	2·806	2·274	2·779	3·117	2·359	2·512	2·600
Grm. calories per kgm.	0·55	0·52	0·57	0·49	0·58	0·62	0·50	0·52	0·52
Grm. calories per kgm. per square metre	0·297	0·281	0·308	0·265	0·314	0·335	0·270	0·281	0·281
Grm. calories per metre per sq. metre	28·32	27·30	30·68	24·86	30·61	34·08	25·79	27·47	28·54

TABLE X.—VARYING LENGTH OF PACE; RATE CONSTANT. CAMPBELL.

	Normal pace			Long pace			Short pace		
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation litres per minute	15·83	16·30	18·24	18·78	20·22	20·38	16·74	17·81	18·77
Oxygen intake in c.c. per minute	925	859	989	1,010	1,061	1,182	944	979	1,027
Calories per minute	4·419	4·177	4·720	4·899	5·157	5·682	4·570	4·770	5·012
Calories per square metre per minute	2·694	2·359	2·649	2·768	2·915	3·211	2·583	2·698	2·832
Grm. calories per kgm.	0·53	0·49	0·53	0·59	0·60	0·64	0·55	0·55	0·572
Grm. calories per kgm. per sq. metre	0·299	0·276	0·299	0·333	0·338	0·361	0·310	0·310	0·32
Grm. calories per metre per sq. metre	29·46	25·79	28·96	30·27	31·67	35·11	28·24	29·50	30·97

obtained with the short stride (see values arranged in Tables IX and X). When each load is considered in terms of length of stride (see Table XI), it will be noted that it is most economical to carry the light load with a long stride, the medium load with a normal stride and the heavy load with a short stride, in other words it would seem that for economy of carriage the length of stride is in inverse proportion to the weight of the load. The consideration of the mean of the results from the two subjects clearly shows

when the figures for the cost in gramme calories per horizontal kilogrammetre is considered that although the normal stride is the least costly the short stride runs it very close (see fig. 8). The following figures which are the mean of all the values show this :

	Normal		Long		Short
Grm. calories per kgm. per square metre	0·293	..	0·324	..	0·295

TABLE XI.—VARYING LENGTH OF PACE: RATE CONSTANT. SUMMARY.

	35 per cent			40 per cent			45 per cent		
	Normal	Long	Short	Normal	Long	Short	Normal	Long	Short
Richardson.									
Ventilation litres per minute	17·59	20·11	17·95	18·00	19·34	19·83	18·72	20·75	20·30
Oxygen in c.c. per minute	994	870	906	947	1,076	960	1,063	1,195	994
Calories per hour	287·8	252·4	261·8	277·2	310·6	278·8	311·3	345·9	288·5
Calories per square metre per hour	155·4	136·4	141·5	149·8	167·9	150·7	168·4	187·0	156·0
Grm. Calories per kgm.	0·55	0·49	0·50	0·52	0·58	0·52	0·57	0·62	0·52
Campbell									
Ventilation litres per minute	15·83	18·78	16·74	16·30	20·22	17·81	18·24	20·38	18·77
Oxygen in c.c per minute	925	1,010	944	859	1,061	979	989	1,182	1,027
Calories per hour	265·1	293·9	274·2	250·6	309·4	286 2	283·2	340·9	300·6
Calories per square metre per hour	161·6	166·1	155·0	141·5	174·9	161·9	158·9	192·7	169·9
Grm. Calories per kgm.	0·53	0·59	0·55	0·49	0·60	0·55	0·53	0·64	0 57
Average R. and C.									
Calories per square metre per hour	158·5	151·3	148·3	145·7	171·4	156·4	163·6	189·8	163·0
Grm. calories per kgm.	0·54	0·54	0·53	0·51	0·59	0·54	0·55	0·63	0·55
Grm. calories per kgm. per square metre	0·298	0·299	0·290	0·278	0·326	0·295	0·303	0·348	0·301
Grm. calories per metre per square metre	28·89	27·57	27·02	26·55	31·24	28·49	29·82	34·59	29·76

Grm. calories, per hour, square kgm. Mean for *all* loads, N. 0·53, L. 0.59, S. 0·54.

When the cost in gramme calories per metre covered at the different paces is considered it will be noted that again, although the general curve followed resembles the foregoing with the lowest value at the forty per cent load at the normal pace and with the long and short strides with the thirty-five per cent load, the difference in cost is less pronounced than might have been anticipated (see fig. 9). The following figures are the mean of all the values in gramme calories, irrespective of the weight of the load :—

	Normal		Long		Short
Grm. calories per metre per square metre	28·43	..	31·13	..	28·72

Again it will be noted that in the matter of economy of cost the short stride runs the normal very close.

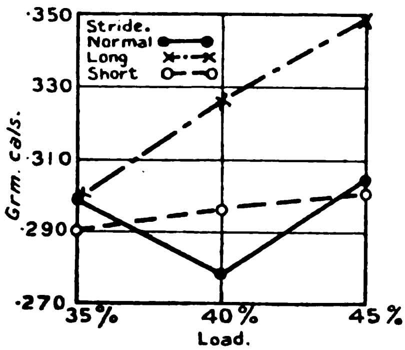


FIG. 8.

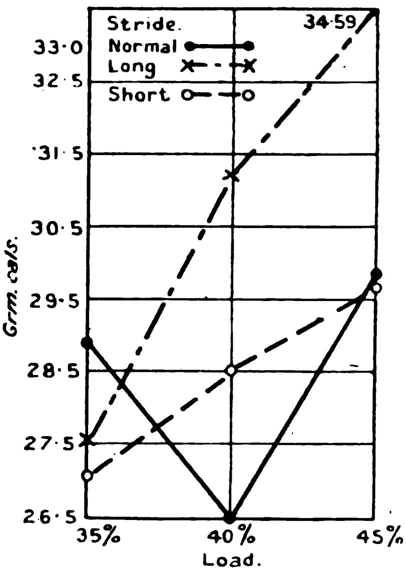


FIG. 9.

FIG. 8.—Varying Stride. Grm. calories per kgm. per square metre.
FIG. 9.—Varying Stride. Grm. calories per metre per square metre.

(4) *Unit Distance in Varying Time.*

In the following series of experiments we carried out an investigation on the influence of speed of movement but in another fashion and for another purpose. The question in this instance might be posed thus: If unit distance has to be covered in unit time would it be least costly to march straight through at a moderate rate of marching without a rest, or to increase the marching rate and the duration of the rest pauses? There are really two answers to this question, the physiological cost answer, and the purely subjective answer, i.e., the general effect on the man who has to carry out the march. As a matter of fact the subjective effect will always be the one which will govern the situation. We are, however, not concerned with this probably predominantly psychical problem at the moment. We were fully alive to the military aspect of the problem, namely that it is essential that when the soldier has reached his objective he should be able to handle his rifle with accuracy in the shortest possible time. We endeavoured both in these experiments and in others to test this capacity, but, so far, no apparatus has yet been devised which will give a true record of the state of physical fatigue of the subject. Indeed some workers on the fatigue problem maintain that the measurement of the state or degree of fatigue is impossible. We, in our experiments as they were for purely military purposes, tried to determine the degree of fatigue by using an ordinary service rifle fitted with a portable subtarget and carrying out grouping tests at intervals after the cessation of the march. We also tried

to determine the degree of tremor by replacing the ordinary small target by smoked paper, and having fixed a bristle or a hair to the end of the needle of the subtarget apparatus to record the amount of swing of the needle by the continuous trace made by the bristle on the smoked paper which it just touched. Many records were made but no very definite conclusive result was obtained when these records were analysed. It is quite true that most often the group was a poor one immediately after the cessation of the march, but this was not constantly the case, and no relation could be determined by this means of the degree of fatigue or exhaustion brought about by the march which preceded the test (see Tracings 3 and 7). Dr. Wishart, lecturer in the physiology department, who was at the time attempting to determine the degree of fatigue induced by other types of work, gave us the loan of his various types of apparatus and his assistance, but again without decisive result. All that one can say with a reasonable degree of certainty is that if the work has been exhaustive enough there is a certain but varying degree of incoordination (muscle? central nervous system?) for some two or three minutes immediately after the cessation of the work, but at the expiry of this time although the subject may subjectively feel fatigued there is no physiologically detectable derangement. The exception to this would seem to be when the work done is carried out by abnormal groups of muscles, i.e., when the type of work is very different to that which the subject tested is in the habit of performing. Under these conditions lack of coordination seems to last longer. It is just possible that the short disturbance of coordination immediately following the cessation of work is due to the over-action of the circulatory system which takes some two or three minutes to return to something approaching its normal condition as regards pulse rate and blood-pressure.

Two sets of experiments were in reality carried out; in the first the unit distance to be covered in unit time was 3,500 metres in sixty minutes, and in the second 5,010 metres in the same time. In both tests five separate experiments were carried out; the march was done at the rate of (1) 58·3 metres; (2) 63·6 metres; (3) 70·0 metres; (4) 77·8 metres; and (5) 87·5 metres per minute. This means in time that the total ground was covered in sixty minutes, fifty-five minutes, fifty minutes, forty-five minutes, and forty minutes, the balance of the hour period was taken up with resting. The pace was the normal pace and the load forty per cent. The method in which the test march was carried out was as follows:—

The subject after the determination of the lying metabolism, properly equipped, started marching at one of the selected rates. This preliminary march was continued for such a time that it amounted to one-half of the duration of the experimental march, i.e., it formed one-third of the total marching period of the experiment, then the experimental march proper began. The first portion of this march amounted to one-half the total experimental period proper.

At the conclusion of this part of the march the rest pause was made, its duration, of course, depending on the rate of marching. At the conclusion of the appropriate rest pause the other half of the experimental march was carried out. In this way using three periods, it was possible to test the influence of the duration of the rest pause. During the first half of the experimental march two-thirds of the way through a sample of the expired air was collected, and in the post rest marching period two samples were collected after the expiry of (*a*) one-third of the marching time, and (*b*) after the expiry of two-thirds of the marching time. During these marches observations were also made on the pulse rate and blood-pressure, and as already noted, an attempt was made to determine the degree of fatigue. The timing of one of the actual experiments will probably make our method of procedure more clear. Thus in the experiment on marching 3,500 metres within the hour at 70·0 metres per minute, i.e., with a rest pause in the course of the march of ten minutes, the record is as follows: Rest, lying, thirty minutes, metabolism determined. March began. Marched twenty-five minutes. Experimental period started; continued march for twenty-five minutes (sample of expired air after sixteen minutes marching). Rest ten minutes. Resumed march, and continued marching for twenty-five minutes (first sample of expired air after eight minutes, second after sixteen minutes). The same procedure was adhered to in the second set of experiments in which 5,010 metres were done in sixty minutes at the rate of 83·5 metres per minute; fifty-five minutes at 91·5 metres; fifty minutes at 100·2 metres; forty-five minutes at 111·3 metres; and forty minutes at 125·3 metres per minute.

TABLE XII.—Unit Distance and Time; Varying Rest Periods.

Richardson: Forty per cent Load; Rate of March 3,500 Metres per Hour.

Rest in minntes ..	0		5		10		15		20	
Marching rate metres per minute	58·3		63·6		70·0		77·8		87·5	
	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest
Ventilation litres per minute	—	9·59	10·17	9·95	12·33	11·24	12·33	11·53	16·18	14·76
Oxygen intake in c.c. per minute	—	496	538	526	615	588	676	634	840	790
Calories per minute..	—	2·356	2·594	2·533	3·010	2·864	3·276	3·069	4·140	3·902
Calories per sq. metre per minute	—	1·274	1·403	1·370	1·618	1·539	1·772	1·660	2·238	2·110
Grm. calories per kgm.	—	0·411	0·414	0·404	0·433	0·412	0·428	0·401	0·477	0·450
Grm. calories per kgm. per sq. metre	—	0·222	0·223	0·218	0·234	0·222	0·231	0·216	0·257	0·243
Grm. calories per metre	—	40·4	40·8	39·8	43·0	40·9	42·1	39·4	47·3	44·6
Grm. calories per metre per square metre	—	21·84	22·04	21·52	23·24	22·11	22·75	21·31	25·57	24·65

TABLE XIII.—Unit Distance and Time; Varying Rest Periods.

Campbell: Forty per cent Load. Rate of March 3,500 Metres per Hour.

Rest in minutes ..	0		5		10		15		20	
Marching rate metres per minute	58·3		63·6		70·0		77·8		87·5	
	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest
Ventilation litres per minute	—	8·60	10·70	8·72	9·80	9·50	11·91	11·41	13·03	13·78
Oxygen intake in c.c. per minute	—	421	527	439	576	595	630	630	785	791
Calories per minute..	—	2·062	2·597	2·137	2·729	2·821	3·089	3·065	3·602	3·647
Calories per square metre per minute	—	1·164	1·468	1·209	1·543	1·595	1·745	1·731	2·036	2·062
Grm. calories per kgm.	—	0·373	0·428	0·353	0·413	0·427	0·418	0·415	0·434	0·439
Grm. calories per kgm. per square mile	—	0·211	0·242	0·199	0·233	0·241	0·236	0·234	0·245	0·248
Grm. calories per metre	--	35·4	40·8	33·6	39·0	40·3	39·7	39·4	41·2	41·7
Grm. calories per metre per square metre	—	20·0	23·0	19·0	22·0	22·8	22·4	22·3	23·3	23·6

TABLE XIV.—Unit Distance and Time; Varying Rest Periods.

Richardson: Forty per cent Load. Rate of March 5,010 Metres per Hour.

Rest period in minutes	0		5		10		15		20	
March rate: metres per minute	83·5		91·5		100·2		111·3		125·3	
	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest	B-fore rest	After rest
Ventilation litres per minute	—	13·93	16·28	17·25	20·47	21·22	—	30·02	47·23	46·46
Oxygen intake in c.c. per minute	—	774	894	927	1,167	1,194	—	1,645	2,305	2,310
Calories per minute ..	—	3·758	4·367	4·555	5·686	5·811	—	8·051	11·381	11·420
Calories per square metre per minute	—	2·034	2·381	2·463	3·073	3·141	—	4·352	6·151	6·173
Grm. calories per kgm.	—	0·456	0·478	0·499	0·576	0·589	—	0·750	0·922	0·924
Grm. calories per kgm. per square metre	—	0·246	0·258	0·270	0·311	0·318	—	0·405	0·498	0·499
Grm. calories per metre	—	44·94	47·21	49·24	56·74	57·99	—	73·39	90·86	91·17
Grm. calories per metre per square mile	—	24·29	25·50	26·61	30·67	31·34	—	39·67	49·11	49·28

TABLE XV.—Unit Distance and Time; Varying Rest Periods.

Campbell: Forty per cent Load; Rate of March 5,010 Metres per Hour.

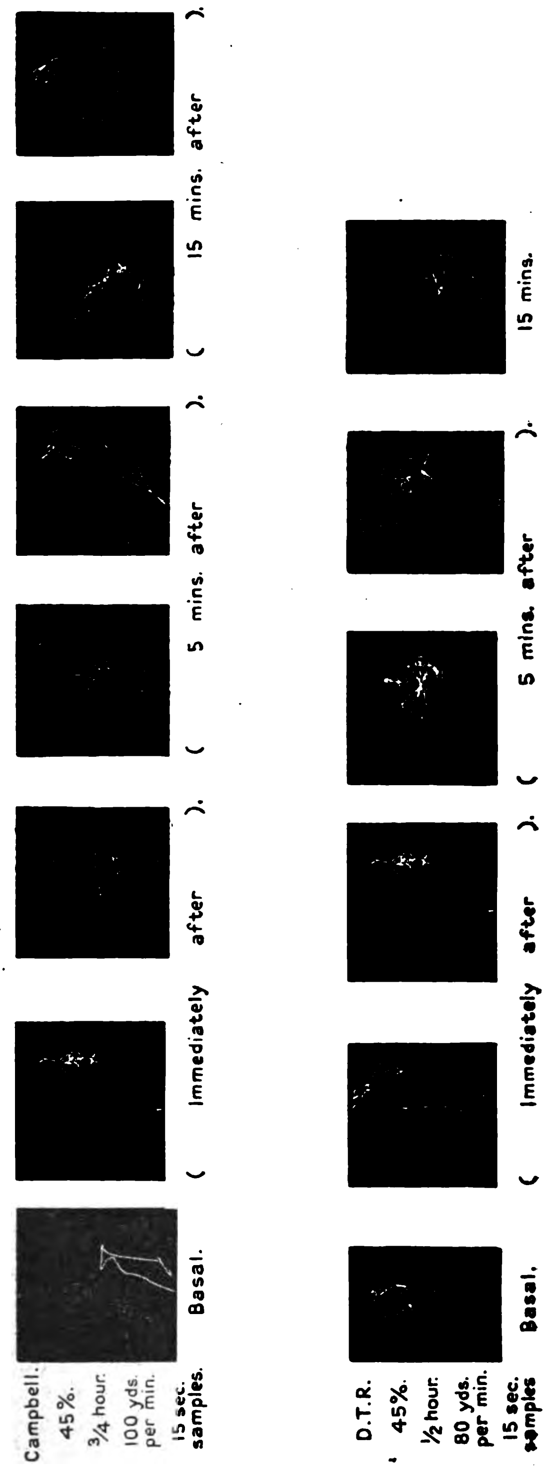
Rest period in minutes	0		5		10		15		20	
March rate metres per minute	83·5		91·5		100·2		111·3		125·3	
	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest
Ventilation litres per minute	—	14·28	15·87	19·48	20·09	19·98	—	30·45	55·35	52·98
Oxygen intake in c.c. per minute	—	757	—	907	1,024	1,025	—	1,606	2,094	2,093
Calories per minute..	—	3·677	--	4·391	5·083	5·055	—	7·825	10·362	10·472
Calorles per sq. metre per minute	—	2·077	—	2·505	2·871	2·856	—	4·434	5·853	5·915
Grm. calories per kgm.	—	0·464	—	0·519	0·534	0·532	—	0·767	0·875	0·885
Grm. calories per kgm. per square metre	—	0·262	—	0·293	0·302	0·301	—	0·433	0·494	0·500
Grm. calories per metre	—	44·03	—	47·47	50·72	50·44	—	71·33	82·73	83·60
Grm. calories per metre per square metre	—	24·87	—	26·81	28·65	28·49	—	40·29	46·74	47·23

TABLE XVI.—UNIT DISTANCE AND TIME; VARYING REST PERIODS. SUMMARY. LOAD, FORTY PER CENT.

(1) March period in minutes	60	55	50	45	40	60	55	50	45	40
(2) Rest period in minutes	0	5	10	15	20	0	5	10	15	20
(3) March rate, metres per minute	58·3	63·6	70·0	77·8	87·5	83·5	91·5	100·2	111·3	125·3
(4) Net calories per square metre per minute, March period	1·219	1·337	1·575	1·716	2·101	2·056	2·467	2·990	4·393	6·030
(5) Net calories per square metre, March period (1)	73·14	73·51	78·75	77·22	84·04	123·33	135·66	149·48	197·69	241·20
(6) Calories per square metre lying. Rest period (2)	—	3·71	7·52	12·54	16·39	—	3·84	7·52	9·21	14·97
(7) Total calories per square metre per hour, March and Rest (1 and 2)	119·82	118·03	123·87	127·38	133·21	168·57	181·74	194·10	234·52	286·11
(8) Grm. Calories per kgm. per square metre based on March and Rest (7)	0·354	0·347	0·365	0·376	0·393	0·348	0.375	0·402	0·501	0·591
(9) Grm. calories per kgm. per square metre based on net March cost (5)	0·216	0·217	0·233	0·229	0·248	0·255	0·280	0·309	0·414	0·499
(10) Grm. calories per metre per square metre based on March and Rest (7)	34·23	33·72	35·39	36·39	38·06	33·65	36·28	38·74	46·81	57.11
(11) Grm. calories per metre per square metre based on net March cost (5)	20·91	21·01	22·49	22·05	24·01	24·61	26·95	29·84	39·47	48·13

The results of these two sets of experiments have been dealt with separately in Tables XII, XIII, XIV, XV, and the combined results are considered in Table XVI. Tables XII to XV give the results obtained both before and after the rest pause at both rates of marching. In Tables XII and XIII at 3,500 metres per hour when the ventilation per minute is examined, it will be noted that with the single exception of the twenty minutes' rest period experiment with Campbell Table XIII, the ventilation rate is reduced as the result of the intervening rest. This reduction is particularly well marked in the case of Richardson Table XII. There does not, however, seem to be any relation between the extent of the post rest reduction and the duration of the rest pause. In the case of the more exhaustive rate of marching, 5,010 metres per hour, Tables XIV and XV, the rest pause is not followed by this reduction in the case of Richardson (Table XIV) except in the last of the series, i.e., the twenty minutes rest, whereas with Campbell (Table XV) there is a very slight reduction in the ten minutes rest, and a more marked reduction in the twenty minutes rest experiment.

In the case of the oxygen consumption, Table XII shows that with Richardson there was quite a definite reduction in the intake of oxygen following the rest, but the results with Campbell Table XIII are somewhat


Campbell.
45%.
3/4 hour.
100 yds. per min.
15 sec. samples.
Basal.
(Immediately after).
(5 mins. after).
(15 mins. after).
D.T.R.
45%.
1/2 hour.
80 yds. per min.
15 sec. samples
Basal.
(Immediately after).
(5 mins. after).
15 mins.

more irregular, indeed there might be said to be a slight but definite tendency towards an actual increase in the oxygen intake. When tables are considered, it will be seen that with Richardson (Table XIV) with the more rapid rate of marching there is a definite increase in the oxygen intake in the post-rest period, whereas with Campbell (Table XV) in the two complete experiments available the evidence would seem to show that the rest had little or no influence on his metabolism.

When the calorie cost is considered, it is found to follow pretty closely, as it ought to if the experiment is properly carried out, the curve of the oxygen intake. The examination of the cost in gramme calories per horizontal kilogrammetre and per metre distance is interesting, especially when a comparison is made between the marching distance of 3,500 and 5,010 metres. The results from Tables XIII to XV are summarized in the following table :—

AVERAGE COST IN GRAMME CALORIES.
(*a*) Per horizontal kgm. (*b*) Per metre.

Marching rate metre per minute (3,500 metre series)	58·3	63·6		70·0		77·8		87·5	
	No rest	Before rest	After rest	Before rest	After rest	Before rest	After rest	Before rest	After rest
Gramme calories per horizontal kgm.	0·392	0·421	0·379	0·423	0·419	0·423	0·408	0·455	0·455
Ditto per square metre	0·216	0·232	0·208	0·233	0·231	0·233	0·225	0·251	0·245
Gramme calories per metre	37·9	40·8	36·7	41·0	40·6	40·9	39·4	44·2	43·1
Ditto per square metre	20·9	22·5	20·3	22·6	22·5	22·6	21·8	24·4	24·1
Marching rate metre per minute (5,010 metre series)	83·5	91·5		100·2		111·3		125·3	
Gramme calories per horizontal kgm.	0·460	0·478	0·509	0·555	0·560	—	0·758	0·898	0·909
Ditto per square metre	0·254	0·258	0·281	0·306	0·309	—	0·419	0·496	0·499
Gramme calories per metre	44·48	47·21	48·35	53·73	54·21	—	72·36	86·79	87·38
Ditto per square metre	24·58	25·50	26·71	29·66	29·91	—	39·98	47·92	48·25

It will be noticed that when the results are examined in terms of the cost per horizontal kilogrammetre, that (1) in the first series there is a definite reduction in the cost of performance in the post-rest period, whereas in the second series there is just as definite a rise in cost in the same period, and (2) that the cost per horizontal kilogrammetre remains approximately constant, as might have been expected from the previous work, up to a rate close to the economic maximum of eighty metres per minute. These results are shown in more dramatic form in the graph fig. X. It will be noted that the greatest fall in cost after rest took place after the five minutes rest in the 3,500 metre series.

When the results are examined in terms of the cost per metre travelled it is again evident that here too the cost in the post-rest period in the first series is slightly but definitely below the pre-rest cost, and is slightly but definitely above in the second series.

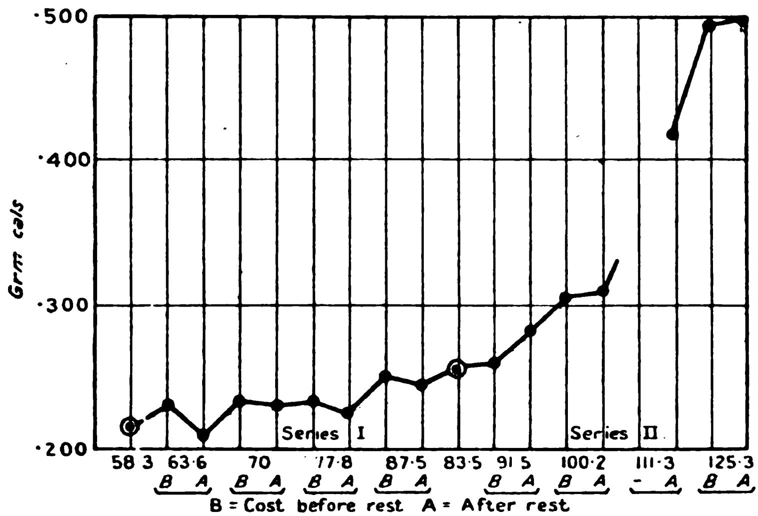


FIG. 10. **Average grm. calories per ~~kgm.~~ per square metre. Influence of Rest.**

It is very evident, then, that when the rate of march exceeds the maximum economic rate, that the effects of the stimulation are such that they do not rapidly pass away, and that although it is possible that "rest," i.e., reduction in the feeling of fatigue or tiredness, may have been attained there has been no apparent relief to the metabolic cost. It is to be regretted that a third series of similar marches was not carried out, in which repeated marches, say at 100 metres per minute, were made with gradual variation in the duration of the rest pause. It is possible that although a rest pause of ten minutes did not suffice to bring the cost of the post-rest march down to a value the same as or below the pre-rest cost if the rest pause had lasted fifteen minutes, this result might have been attained.

When the results summarizing the whole series of observations, no attention being paid to whether the results were obtained before or after the rest pause, are considered in Table XVI, a number of interesting and important points will be seen to emerge. Thus in 4 there is given the net cost in calories per square metre per minute of the march, and as is to be expected, there is a steady and progressive increase, which becomes much more rapid at the higher rates of marching. The variation in the cost between any two rates seems to bear no definite relation to the actual extent of the increase in speed. It will be noted that the two marches at 83·5 metres and 87·5 metres, the first rate of the second series and the final rate of the first series fall into their proper place. 5 gives the total net cost in calories per square metre for the *actual* period of marching. It will be noted that up to approximately the rate of eighty metres per minute there is no striking difference in the cost of the performance, but thereafter there is a very marked increase in the cost. In this connexion reference must be made to the actual cost per metre distance covered, see

10 and 11. 6 gives the cost in calories of the basal requirements for the rest period. Inasmuch as these values were determined in the completely quiescent state, and the rest periods, to which attention is now drawn, were intervals between two periods of marching, they really cannot be held to be comparable.

It has now been definitely determined by many workers that metabolism is stimulated by muscular activity for a very long time, extending even to many hours, after the cessation of work. Several investigators have attempted to give actual values to this increased cost as the result of immediately preceding muscle activity. Thus Loewy has stated that, in his experience, the increased consumption of oxygen characteristic of muscular work returns to normal after moderate work in the course of about six minutes and after hard work in about ten minutes. His general conclusion was that on the average the increase in oxygen consumption during the whole of the post-work period is about equal to the oxygen consumption during one minute of the working period, provided the work is moderate in amount. If the work has been very hard and has taxed the subject, then the increased post-work oxygen intake may equal the intake during two or three minutes of the work. Benedict and Cathcart found themselves in agreement with Loewy as regards the increase in oxygen intake in the post-work period where moderate work was concerned, but in the case of *really* severe work the after effects were much greater and much more prolonged. Recently the question has again been specially investigated by various workers who have determined the oxygen intake after work of different types. Thus Campbell, Douglas and Hobson and Krogh and Lindhard have studied the recovery phase after work on a bicycle ergometer, and Lupton, in A. V. Hill's laboratory, on various other forms of exercise. It may be stated generally that with normal, healthy men, provided the exercise is not severe recovery is rapid, the return to the pre-work oxygen intake being reached in about ten minutes. If the exercise is prolonged internal adjustment of the organism takes place so that the greater part of the recovery process is completed during the performance of the work, i.e., during the progress of the muscular activity a condition of equilibrium is reached, so that the total oxygen deficit becomes constant. In such experiments, as in those of Loewy, the post-work oxygen consumption equals about a minute of the work consumption. Lupton in some of his experiments with exercise so violent that it was only possible to carry it out for very short periods found that, as A. V. Hill puts it, the body might for brief periods go into debt for oxygen to the extent of 3,000 or 4,000 cubic centimetres. Hill also quite properly pointed out that it is this power to go into debt alone which makes it possible for the body to carry out the more violent bursts of exercise. This means of course that if the body could only, so to speak, deal in cash, the capacity for short-lived, violent effort, such, for example, as the assault in bayonet fighting, would be very materially reduced.

(*To be continued.*)

ARMY HYGIENE ADVISORY COMMITTEE REPORT No. 2.

An Investigation on the Motion Study of Digging and the Energy Expenditure involved, with the Object of increasing Efficiency of Output and economizing Energy.

By Captain A. G. STEVENSON.
Royal Army Medical Corps.
AND
Captain R. L. BROWN.
Royal Engineers.

(*Continued from p.* 45.)

SECTION IV.

PRACTICAL AND SCIENTIFIC TESTS OF THE PROPOSED NEW METHODS.

Tests of the proposed new methods were carried out on the following lines :—

(1) An initial practical test to prove the feasibility of these methods being taught in a drill.

(2) By the determination of energy expenditure on work performed under the present and proposed new methods to arrive at a definite conclusion as to the increase or decrease in energy, cost and output.

(3) By cyclegraph records of the present and proposed new methods to show a comparison of their respective motion paths.

(4) By slow motion photographs of the present and proposed new methods to show their respective actions.

(5) By a final practical test on two equal squads of untrained recruits to prove the increased efficiency (if any) of the proposed new drill.

(1) The initial practical test proved that the methods suggested were feasible in every way and though trained subjects did not show any improvement in shovelling on the new method, the fact had been realized that men trained in one particular method of shovelling would require more than a few demonstrations on the improved method to change their natural mode at once, and that the untrained subjects would show the relative values of the two methods to a much greater extent and with less teaching. This was proved by comparing the figures of the two unskilled subjects "H" and "I."

(2) Energy expenditure. Tests on the energy costs of picking, shovelling and combined work were first made on various subjects to give a rough idea of what the actual cost of digging was.

The figures showed that digging (pick and shovel work) from the point of view of energy expenditure is relatively costly and therefore frequent

rest pauses are a necessity. Its cost may be compared to that of slow double marching carrying a total weight (clothing and equipment) of about ten kilos.

Picking, itself, is less expensive than shovelling, and these two types of work are so different in action that the one affords relief to the other and forms a distinctive rest to the different muscles used. The change over from one tool to the other (about five seconds on the average) is also a rest. In a long combined spell, therefore, the average hourly cost would fall below the figures actually obtained.

(A) Comparison of the Relative Energy Costs and Outputs of the Present and Proposed new Methods of Shovelling.

Condition of soil, tools, base, height and length of throw, rate and general conditions were standardized for these experiments, and unskilled subjects were chosen as being likely to give better relative results with the two methods.

The methods were performed alternately throughout the test series so that the factor of "freshness" would be eliminated. The subject "warmed up" to the work for a period of ten to fifteen minutes prior to the expired air being collected.

The actions and style of the present method were those taught and used at present in the S.M.E. Chatham.

Those of the proposed method were as described in Section 3 of this report.

Results.—The results obtained were very satisfactory in every way. Not only was the average output increased by nearly six per cent, but the average energy cost showed an actual decrease of over ten per cent; thus making for a total increased efficiency of sixteen per cent.

We are convinced that this great saving in energy with increased output is a result of combining the muscle actions of the trunk, legs and arms in the final throw, as against their separate action in the present method.

(B) Comparison of the Relative Energy Costs and Outputs of the Present and Proposed new Methods of Picking.

Conditions of experiment were, as before, standardized; the actual output was measured by the amount of loose earth picked down from a definite working face to the trench base.

The originally devised new method when put to the test resulted in the large increase in output of twenty-nine per cent, but had a correspondingly large increase in energy cost of eighteen per cent, which we considered too expensive and so discontinued it.

Thus originally the pick-head was carried straight up to the per-

pendicular in the upward swing and the arms were not flexed to any degree. The cost of this was high.

It was now decided to allow the forward arm to bend to a right angle at the elbow at the top of the swing while still preventing the pick-head from falling behind the shoulder.

The actions and style of the present method were those taught and used at present in the S.M.E. Chatham.

Results.—The results obtained showed an average output increase of 9·5 per cent with a slight increase in average energy cost of 1·7 per cent, totalling up to an increased efficiency of nearly 8 per cent. These figures, though not as favourable as those obtained on shovelling, show nevertheless a distinct improvement over the present method.

In a combined spell of picking and shovelling therefore the proposed methods would result in an increased efficiency of nearly 24 per cent.

(3) *Cyclegraph Study of the Present and Proposed New Methods.*—To find out if the new drill drawn up and taught produced movements whose motion paths corresponded to those which we considered the most favourable in our preliminary study, cyclegraph records were made of a trained subject performing the picking and shovelling cycles in both the present and proposed methods.

Prints of the actual photographs taken are shown in fig. 8, and an explanatory table of these photographs on p. 103.

The results showed that the new drill was based on the correct lines and that the drill of the present method of shovelling accentuated if anything the rise in the path of the backward swing of the shovel prior to the throw (described in detail in the previous cyclegraph section).

The picking records of the new method showed the limited upward swing and the continuation of the raking stroke with the last movement of the break.

(4) *Slow Motion Study.*—Cinematographic records were taken of both the present and proposed new styles, and selected photographs at different points of the cycle are attached.

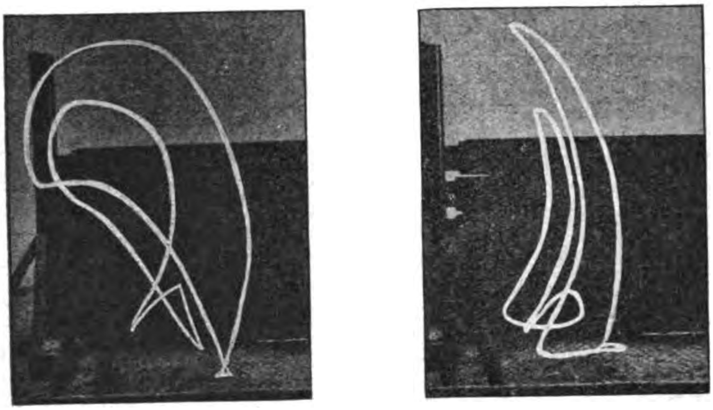
These show very clearly the differences in action between the two methods and will help to demonstrate efficient and inefficient movements.

(5) *The Final Practical Test.*—To test the efficiency of the drill on large numbers of men, and to prove its likelihood of increasing output and economizing energy, two equal squads of *untrained raw recruits* were chosen; conditions of height, weight, age, previous service and experience in digging being taken into account, and the two squads balanced as equally as possible as regards all these factors. Each squad to start with numbered twenty recruits. Three N.C.O.s instructed in the present system of digging drill were put in charge of one squad, an equal number of N.C.O.s instructed in the new type of drill were put in charge of the other squad.

PICKING AND SHOVELLING.

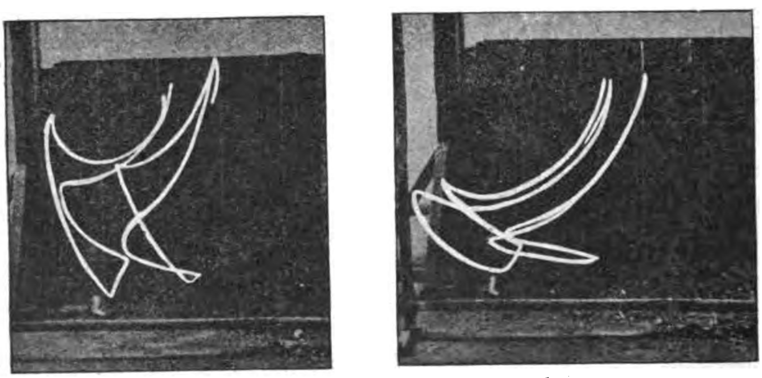
Present Method. *Proposed Method.*

1 1*a*



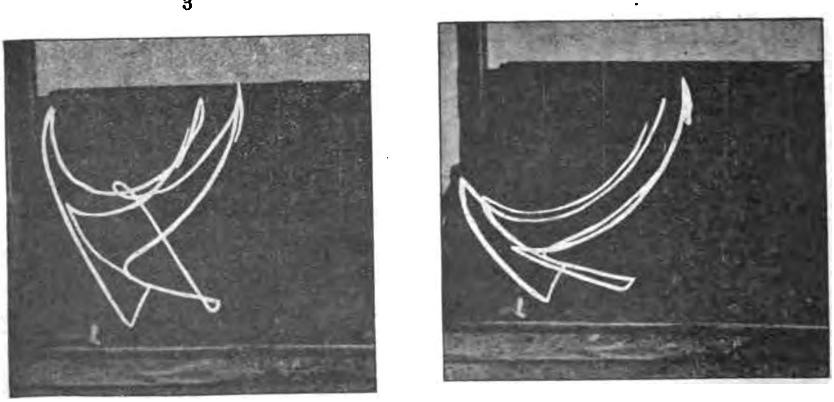
Pick-head and forward hand.

2 2*a*



T-piece and forward hand—high throw over arrow.

3 3*a*



T-piece and forward hand—long throw over arrow.

FIG. 8.

EXPLANATORY TABLE OF CYCLEGRAPH RECORDS IN FIG. 8

PRESENT METHOD.

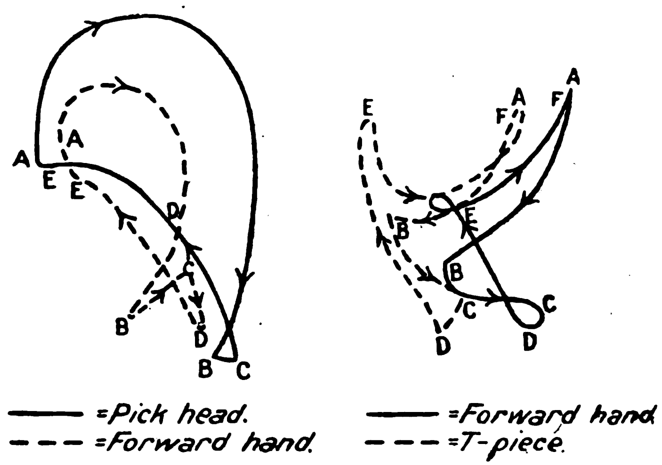
Picking.—(1) Motion paths of pick head (continuous line) and forward hand (dotted line). Shows dropping of the pick head behind the shoulder path DE with the consequent after-raising to the perpendicular; the movement of the forward hand sliding down the helve until it meets the back hand—the absence of a raking stroke.

Shovelling—(2) Motion paths of right hand (on T-piece) (dotted line) and left hand (on helve) (continuous line). Shows rise of path DE caused by the straightening of the knees and body causing the final throw (path EF) to be made by the arms alone.

(3) Paths as in (2). Shows action very similar to above (long throw).

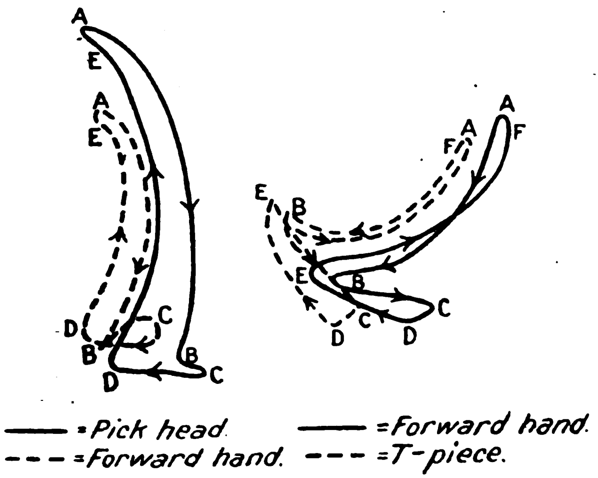
PRESENT METHOD.

Picking. *Shovelling.*



PROPOSED METHOD.

Picking. *Shovelling.*



KEY.

Picking.

A—B = Downward stroke.
B—C = Raising small end of helve to break the earth.
C—D = Raking back the broken earth.
D—E = Raising head of pick upwards over shoulder for next stroke.

Shovelling

A—B = Backward swing.
B—C = Forward thrust,
C—D = Depression of T-piece.
D—E = Backward swing prior to cast.
E—F = Cast.

PROPOSED METHOD.

Picking.—(1a) Motion paths as above. Shows upward swing limited to the perpendicular; the break path BC followed by the raking down of the broken earth to the feet path CD; the limitation of the sliding down the helve movement of the forward hand.

Shovelling.—(2a) Motion paths as above. Shows the low path of action DE, followed by the final throw path EF which is a combined knees, trunk and arms movement. (3a) Motion paths as above. Shows action similar to (2) long throw.

Training was continued over a period of eight days, with three working hours in each day, totalling twenty-four hours.

Tests were carried out on the ninth and tenth days of the period, the first test being a definite task and the second a four-hour spell.

In these tests, which were intended to show the actual increase or decrease in output or time taken to complete the task, we decided to work the squad instructed in the present type of drill, resting at their own times (which is the present method), and to work the squad on the new drill on our rest-pause system (8 minutes work and 2 minutes rest with an extra 3 minutes at the end of each hour's work).

This original idea was somewhat changed at the suggestion of the O.C. Training Battalion R.E., whose recruits were being used in the test.

In order to make a comparison between the two drills alone, unaffected by rest pauses, both squads were worked to the eight-minute and two-minute type of rest-pause in the task work. Also an additional squad of partially trained recruits, but untrained in pick and shovel drill, was selected to complete the comparative series, and worked in its own time and rests.

In the four-hour spell we worked the squad on the new method according to the rest-pause system. Both other squads worked in their own time.

Results were gauged in the task work by the time taken to complete each separate task and then averaged up as shown in the table of results. After-condition was noted.

In the four-hour spell, results were gauged by a careful measurement of output. After-condition was again noted.

Results.—(A) *Task Work.*—43·8 cubic feet solid excavated. Measure of task: 3 feet deep by 4 feet 6 inches long by average breadth 3 feet 3 inches (R.E. pick and shovel).

(1) Squad "A": On the new method (fifteen men).
- (i) Average time taken: 3 hours, 12 2/3 minutes.
- (ii) Condition afterwards: 14/15 good.
- (iii) Average type of soil: Clay, loam and large flints.

(2) Squad "B": On present method (sixteen men).
- (i) Average time taken: 3 hours, 34 1/2 minutes.
- (ii) Condition afterwards: 12/16 good.
- (iii) Average type of soil: Clay, loam and large flints.

(3) Squad "C": Untrained in drill (fifteen men).
- (i) Average time taken: 4 hours, 16 1/3 minutes.
- (ii) Condition afterwards: 10/15 good.
- (iii) Average type of soil: Top nine inches loam, below clay and large flints.

(B) *Four-hour Spell.*—Type of work: Excavating from three feet downwards.

Squad "A": On new method (eleven men).
- (i) Average output: 38·1 cubic feet.
- (ii) After condition: Good, 11/11.
- (iii) Soil: Clay and large flints. One man struck friable chalk at six feet deep.

Squad "B": On present method (twelve men).
- (i) Average output: 31·35 cubic feet.
- (ii) After condition: Good, 12/12.
- (iii) Soil: Clay and flints. Five men struck friable chalk and flints at five feet six inches.

Squad "C": Untrained in drill (eleven men).
- (i) Average output: 26 cubic feet.
- (ii) After condition: Good, 11/11.
- (iii) Soil: Clay and flints; friable chalk and flints at five feet.

These results give the following percentages:—

(1) *Task Work.*

Taking the untrained squad as a basis.

Trained in present drill: 16·4 per cent decrease in time.

Trained in proposed method: 24·7 per cent decrease in time.

Taking "Trained in present drill" squad as a basis.

Proposed drill results in a 10·1 per cent decrease of time.

After-condition was best in the proposed method, next best in the present method, and worst in the untrained.

Soil was equal for the two trained squads and easier for the untrained squad.

(2) *Four-hour Spell.*

Taking the untrained squad as a basis.

Trained in present drill: 20·6 per cent increase in output.

Trained in proposed drill: 46·6 per cent increase in output.

Taking the trained in present drill squad as a basis.

Proposed drill results in a 21·5 per cent increase in output.

After-condition showed no appreciable difference in the three squads.

Soil was easiest for the untrained squad, more difficult for the "present drill" squad, and still worse for the "proposed drill" squad.

Conclusions.

The results given above tend to prove that the new drill recommended for picking and shovelling produces a marked increase in output and a saving in energy. As this is the only test of its type that has been carried

out, the results may not be sufficiently accurate to warrant definite conclusions, but they undoubtedly point to a great increase in efficiency.

A long series of tests, to level up the factors of soil, physique, capabilities of instructors, previous experience and other minor elements which affect results, would alone show true figures.

SECTION V.

REST-PAUSE EXPERIMENTS.

Owing to the necessarily lengthy nature of these experiments, work under this section was started on two subjects only, and two men were selected who would be most likely to give average consistent results.

The method adopted was as follows: Each subject was given four hours' work to do and his rest intervals were carefully controlled by means of a stop-watch. The work consisted of digging a trench three feet wide by four feet deep, and the excavated earth was thrown up on to wooden bankers placed alongside the trench, where it was carefully measured in boxes and the time taken to fill each box was noted. In this way a record was obtained of the subject's output per minute as the time progressed. This method, however, had the disadvantage of not always including an equal number of pick spells and shovel spells in the time period for each box, and thus showed a very uneven estimate of output per minute over short periods. The output during the definite working periods was then noted, in lieu, and gave a much more even result.

Owing to sickness of one of the subjects it became necessary to start another subject working in his place so as to avoid the possibly unsteadying effect on the other subject of working alone. On the return of the subject who went sick his series was completed as was also the series of the new subject. Thus in some cases results have been duplicated.

In preparing the averages for comparison the average of all three subjects' averages has been taken and not the direct average of all experiments in each type of rest pause.

The rest intervals investigated were as follows:—

(1) *Voluntary Rests.* Unorganized.

(2) 12 *minutes work*, 3 *minutes rest* + 2 minutes extra rest at end of each hour. (14 minutes per hour.)

(3) 8 *minutes work*, 2 *minutes rest* + 3 minutes extra rest at end of each hour. (15 minutes per hour.)

(4) 7 *minutes work*, 3 *minutes rest.* All through whole period. (18 minutes per hour.)

(5) *Two complete pick and shovel spells* and 2 minutes rest + 5 minutes rest at end of each hour. (Approx. 15 minutes per hour.)

(6) 5 *minutes work and* 1 *minute rest* + 6 minutes extra rest at end of each hour (15 minutes per hour). A basis was obtained first by finding out the

frequency and length of each subject's rest intervals when working "at his own time"—called by us "voluntary rests."

The first organized rest pause investigated was the 12 *minutes work* 3 *minutes rest* as suggested in S.M.E. Fortification Circular No. 61 on Digging. It became apparent early on in this experiment that this relatively long working spell with so little rest tended to produce exhaustion very quickly, and forced the worker to take longer changing over from pick to shovel and vice versa, and also to depart from the optimum rates in the use of his tools. In view of this an extra two minutes rest were added at the end of each hour. In the last hour's work the final rest pause was brought forward and joined with the previous rest pause so as to avoid ending the period with rest.

The long pause at the end of each hour was generally liked by the subjects and was adopted throughout the experimental series except in the 7 *minutes work*, 3 *minutes rest type*. The bringing forward of the final rest was considered good, but was better dealt with by distributing it throughout the final hour, as in types 8 *minutes* to 2 *minutes* and 5 *minutes* to 1 *minute*.

In each case the worker's own opinion was asked and has been recorded. Further a rough estimate of his condition after work was made.

The weather conditions during these experiments were most uncertain, and on several occasions experiments had to be discontinued owing to rain and the results discarded. On some days the soil was much damper than on others and materially affected output.

Another element which affected the results was the psychological factor, which was ever present to some degree. For instance, subject "D," under the impression that he was going to do the last of his series (experiment 5), worked throughout with the definite intention of "showing what he *could* do." The result was an average output of 90·7 pounds per minute, which shows what a tremendous effect the psychological factor may have on the capacity for work.

In every case the *actual* results have been tabulated and plotted, but an attempt to allow for psychic and other factors has been made. The only satisfactory way of overcoming such difficulties is to carry out a large number of experiments on a large number of subjects and take a general average. This has not been possible in the present work, which only gives a strong indication of the optimum, and not a definite and unchallengeable result.

It is interesting to note in the voluntary rest-pause experiment the two results obtained from subject "D." The first of these was obtained at the commencement of the series, and the second towards the end. In the second the subject had evidently been influenced by the organized rest-pause experiments carried out on him. His rest pauses were more evenly distributed, particularly as regards the amount of rest taken during each hour; and his hourly output was more even. A slight increase in output

is noticeable, though not marked. It was originally intended to apply the same test to the other subjects, but the disbandment of this section made this impossible.

Results.—From a study of the average of all the experiments undertaken the following points will be noted:—

(1) Voluntary rests. The average hourly rest was seventeen minutes three seconds, and the average output was 58·95 pounds per minute. General after-condition was medium. Subjects' opinion: Generally liked (as would be expected).

(2) Twelve minutes work and three minutes rest. This gives an average hourly rest of fourteen minutes. Average output was 58·10 pounds per minute. General after-condition was poor. Subjects' opinion: Working spell too long. Disliked.

(3) Eight minutes work and two minutes rest. This gives an average hourly rest of fifteen minutes. Average output was 65·57 pounds per minute. General after-condition was good. Subjects' opinion: General opinion was that the rest was sufficient. Liked.

(4) Seven minutes work and three minutes rest. This gives an average hourly rest of seventeen minutes fifteen seconds. Average output was 63·42 pounds per minute. General after-condition was very good. Subjects' opinion: Generally liked, but the longer rest at the end of each hour was missed.

(5) Two complete pick and shovel spells—two minutes rest. This approximated to an average rest of sixteen minutes twelve seconds. Average output was 61·0 pounds per minute. General after-condition good. Subjects' opinion: Generally liked.

(6) Five minutes work and one minute rest. This gives an average hourly rest of fifteen minutes. Average output was 69·05. General after condition good. Subjects' opinion: Disliked. Both work spell and rest considered too short.

Taking the voluntary rest-pause experiment as a standard, the percentage increase and decrease in time and output is as follows for the organized rest-pause series:—

Spell	Time	Output
5 minutes and 1 minute	12 per cent decrease	17 per cent increase
8 „ „ 2 minutes	12 „ „	11 „ „
7 „ „ 3 minutes	1 „ increase	8 „ „
Two P. and S. spells + 2 minutes rest	5 „ decrease	3 „ „
12 minutes and 3 minutes	17 „ „	1 „ decrease

Conclusions.

(1) Although the five-minute and one-minute spell shows the best results as regards output and total rest, the subjects' opinion and the fact that it would be difficult to control, rule it out for practical purposes.

(2) The eight-minute and two-minute and the seven-minute and three-minute spells are good for all practical purposes, the division of the time on a ten-minute basis facilitating the control of the working squad.

(3) The two pick and shovel spells could not be controlled in a squad, but would in all probability be the best type for an individual organizing his own rests.

(4) The twelve-minute and three-minute spell is not good, both from results and subjects' opinion.

(5) Generally these results indicate that the onset of fatigue is checked by the introduction of suitable rest pauses. The pauses allow the waste products of muscular work to be got rid of by the system and thus prevent the local paralysing effect of these products on the end plates, and they combine with this a tonic effect on the central nervous system.

SECTION VI.

EXPERIMENTS ON NEW DESIGNS OF TOOLS.

(1) Picks.

Varying weights of pick-heads were tested by the various subjects and the conclusion was reached that a head of about six pounds weight would produce the best results on all types of soil and be suitable for the average physique of the soldier.

The 8-pound head is too heavy and the 4½-pound head a little under weight.

(2) Shovels.

We came to the conclusion early on in our investigations that the present G.S. shovel is too small and too light for average shovelling and is not economic from the point of view of energy expended.

The R.E. shovel produced good results with trained men, but was not quite fitted for average trench work, being a little too broad in the pan and not being adapted for actual digging, i.e., has no tread.

Accordingly various designs of shovel pan were made and constructed on the general principle of combining the average weight of shovel load of the R.E. tool with the digging powers of the G.S. tool.

Unfortunately facilities for construction were not available to furnish us with shovels made to the exact weight detailed, so that though we had the exact sizes desired the weights were in all cases over specification and affected the optimum rate to a slight extent.

The average shovel load however gave interesting results.

Results.—From a consideration of the results obtained on the various designs of shovel tested we are of opinion that for the average man and in all types of soil a design on the following measurements will approach nearer the optimum than any other. (See fig. 11.)

Description.—Pan well scooped, 1⅛ inches at deepest point in pan.

Pan, frog and straps forged from solid. Top edges of pan turned over to form treads.

Pan 13 inches × 9½ inches. Treads ¾ inch × 3 inches. Set of straps and helve as in R.E. shovel. Length 3 feet 5 inches over all. Weight 5 pounds.

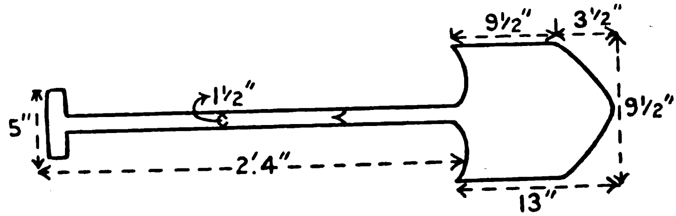


FIG. 11.

ADVANTAGES.

(1) This shovel will take a slightly larger average shovel load on account of the shape of the pan and the fact of the treads preventing earth falling away during the upward throw.

(2) The pan being narrower than the R.E. type, will be more suitable for shovelling in a confined space and in heavier soils.

(3) Owing to its shape and design it can be used for actual digging.

(4) There is no increase in weight over the R.E. shovel.

(5) Combining the qualities and uses of both the R.E. and G.S. shovels it will suffice as a universal type for all services, and will thus do away with the present two types.

SECTION VII.

GENERAL CONCLUSIONS.

(1) We are of opinion that the drill we have formulated for picking and shovelling will, if properly instructed, increase average efficiency in digging by about twenty per cent, by an increase in output and a saving in energy cost.

(2) This twenty per cent increase in efficiency will be obtained over the results of the present drill, and another twenty per cent may be claimed over the results of the untrained man.

(3) It has been proved that this drill can be easily picked up by the average man and will not require more than a few days training.

(4) During a long task or spell we advise a systematized form of rest pauses to be taken. Probably a seven minutes working spell and a three minutes rest period or an eight-minute work and a two-minute rest approach nearest the optimum. These organized rest pauses are easy to control by an N.C.O.

During these working spells the use of the tools should be continued at

the optimum rates of 17-19 throws per minute for the shovel, and 25-30 strokes per minute for the pick.

(5) Various important directions for picking and shovelling have been laid down in Section III, and compliance with them is essential if efficiency is to be aimed at.

(6) We consider a three-four hour spell with the definite rest pauses as advised, an optimum period of work. The subjects will turn out a good output and will be in good general condition afterwards. An average hourly output on this spell will be from twenty-five to thirty cubic feet per hour, in a medium type of soil, and under conditions as laid down in Appendix II, p. 202, Manual of Field Works (All Arms), 1921.

(7) We consider that for the average man and in different types of soil, the best size, shape, and weight of pick and shovel would be as described in Section VI of this report.

(8) Finally, we are of opinion that these conclusions should be thoroughly tested on large bodies of men to prove their general efficiency.

Acknowledgments.

We wish to tender our sincere thanks to the Commandant S.M.E. and R.E. Depot, Chatham, Major-General H. F. Thuillier, C.B., who initiated the investigation, for his genuine interest and support.

Also to the R.E. Board and to the Directorate of Hygiene for facilities granted and helpful criticism.

We are extremely indebted to the Chief Instructor in Fortification, Major Herring, M.C., and his staff, to the staff of the Photographic School, the staff of the Electrical School, the Chief Instructor Mechanical School and Workshops, at the S.M.E. Chatham, for their sympathetic co-operation.

We owe thanks to the Superintending Civil Engineer, H. M. Dockyard, Chatham, for his assistance in procuring suitable skilled navvies for our experimental work; to the Medical Research Council for advice and literature provided; to Professor E. P. Cathcart, F.R.S., and to Lieutenant-Colonel C. R. Sylvester-Bradley, R.A.M.C., for valuable advice and criticism; and finally to the various experimental subjects who were put at our disposal for this investigation, and who spared no efforts to make this work a success.

References.

[1] Hauer, D. J. "Modern Management Applied to Construction," 1918.
[2] Gilbreth, F. B. "Applied Motion Study," 1919.
[3] Taylor, F. W. "The Principles of Scientific Management," 1914.
Cathcart and Orr. "The Energy Expenditure of the Infantry Recruit in Training," 1919.
Farmer, Eric. "Time and Motion Study." Report No. 14. Industrial Fatigue Research Board, 1921.

SCHEME FOR AN EXAMINATION OF MAJORS, ROYAL ARMY MEDICAL CORPS, FOR PROMOTION TO THE RANK OF LIEUTENANT-COLONEL, PART II, HELD IN THE ALDERSHOT COMMAND, FEBRUARY, 1923.

By Major-General GUISE MOORES, C.B., C.M.G., K.H.S.
Army Medical Service.
AND
Brevet Colonel W. G. S. DOBBIE, C.M.G., D.S.O.
Royal Engineers; G.S.O. 2nd Division.

General Idea.

Southland is an overseas power, which has invaded England.

Its Expeditionary Force landed at Portsmouth and Southampton between February 1 and 7, and advanced towards London, opposed by a hastily mobilized English Force.

The standard of training and the organization of the Southland and English Forces are the same as those prevailing in the British Regular Army to-day.

Special Idea—Southland—and Narrative.

Reference—One-inch Aldershot map.

(1) The Southland Expeditionary Force consists of: One corps of three divisions, one cavalry brigade, one infantry brigade for lines of communication.

(2) After the disembarkation of the troops had been completed, Southampton was evacuated and the base concentrated at Portsmouth and Gosport.

(3) During the early part of the advance intense hostility was displayed by the inhabitants who had not hesitated to kill any stragglers and wounded who fell into their hands. Small mobile columns of troops in lorries and armoured cars were organized for the protection of the main roads behind the army.

(4) On February 10 and 11, a hard fight took place on the line Haslemere—Alton, resulting in the withdrawal of the English forces during the evening of the 11th. Both sides had suffered severely, the 1st and 2nd Divisions having sustained about 2,000 casualties apiece, and the Cavalry Brigade 200. About 1,000 enemy wounded fell into the hands of the Southland forces.

(5) At 20.00 hours on the 11th the situation of the Southland Corps was as follows:—

1st Division—In area Hindhead, Headley, Longmoor Camp, Linchmere.

2nd Division—In area Bordon, Alton, Faringdon, Greatham.

Cavalry Brigade—On high ground north-west of Alton.
3rd Division—East Tisted, Medstead, Ripley, West Meon.

The 3rd Division was fresh. The remainder were in touch with the enemy and the men were very tired.

(6) At 20.00 hours on the 11th orders were issued from Corps headquarters of which the following is a précis :—

> (*a*) Enemy appears to be falling back in a north-easterly direction.
>
> (*b*) The 1st and 3rd Divisions and Cavalry Brigade will continue the advance at 08.00 to-morrow—passing through the present outpost line at that hour. The 3rd Division will pass through the 2nd Division which will come into Corps Reserve.
>
> (*c*) The 1st Division will secure the line of the Hog's Back from Farnham (exclusive) eastwards.
>
> The 3rd Division will secure Farnham, Aldershot and the high ground about Caesar's Camp and Hungry Hill.
>
> The Cavalry Brigade will cover the left of the 3rd Division.
>
> The 2nd Division will be prepared to move from its present area toward Farnham and Crondall by 12.00 hours.
>
> (*d*) Rail heads for February 12 will be as under :—
> 1st Division—Petersfield.
> Remainder—West Meon.

For the purpose of this scheme the strength of each division may be taken as 682 officers and 15,850 other ranks; and a cavalry brigade as having a strength of 118 officers and 2,722 other ranks, with one cavalry field ambulance consisting of a headquarters with an establishment of 3 officers and 26 other ranks, and one company of 4 officers and 66 other ranks. With the cavalry field ambulance are 6 light motor ambulance cars, 4 heavy motor ambulance cars and 6 light horsed ambulances.

It is further to be noticed that each field ambulance consists of a headquarters with a strength of 4 officers and 51 other ranks, and two companies each with 3 officers and 50 other ranks. Each field ambulance has 6 light motor ambulance cars, 2 heavy motor ambulance cars and 4 heavy horsed ambulance wagons.

A motor ambulance convoy may be considered to consist of three sections, each with twenty-five motor ambulance cars.

A casualty clearing station accommodates 50 patients in beds and 150 on stretchers, and has an establishment of 8 officers and 76 other ranks.

General hospitals are of two sizes—one to accommodate 600 patients including 60 officers, and the other to accommodate 1,200 patients including 120 officers.

The establishment of the former is 19 officers, 135 other ranks; and of the latter, 31 officers and 215 other ranks.

REQUIRED FROM EACH OFFICER BY FEBRUARY 7, 1923.

(1) A general statement of the medical organization on the lines of communication, giving assumed positions for the various medical units.

(2) A medical appreciation of the situation by D.D.M.S., Corps Headquarters (D.D.M.S. of the Force), on the evening of February 11, after receipt of Corps Orders for operations on the 12th.

Headquarters, Aldershot Command.

January 30, 1923.

SOUTHLAND FORCE.

GENERAL STATEMENT OF THE MEDICAL ORGANIZATION OF THE LINES OF COMMUNICATION, GIVING ASSUMED POSITIONS FOR THE VARIOUS MEDICAL UNITS.

General headquarters at Portsmouth with advanced general headquarters at Petersfield.

Headquarters, lines of communication with A.D.M.S., D.A.D.M.S., A.D.H., and two E.M.O.'s (one for Gosport) at Portsmouth. Matron-in-Chief and Embarkation Sister; Consulting Surgeon and Consulting Physician.

General Hospitals.—Two general hospitals of 1,200 beds each, and two of 600 beds each, are established at Portsmouth in existing buildings, and two general hospitals of 1,200 beds and one of 600 beds each, will be opened in existing buildings at Gosport. Total hospital accommodation at base 6,600, or slightly less than 10 per cent of total force. Should the necessity arise each of these units could be expanded at fairly short notice. No account has been taken of beds in casualty clearing stations, or convalescent depots.

Convalescent Depôts.—One to accommodate 1,000 men at Portsmouth, and one to accommodate 1,000 men at Gosport; each could be expanded to 2,000.

Medical Stores.—One base depot medical stores at Portsmouth ; one advanced depot at Petersfield and one at West Meon.

Ambulance Trains.—Three ambulance trains of 300 beds each, based on Portsmouth.

Motor Ambulance Convoys.—Two of three sections each, twenty-five cars in each section. One M.A.C. will be required for work within the Corps, of which one section of twenty-five cars would be based on Petersfield and the remaining two sections on West Meon. It would be essential to have the second M.A.C. at the base, one section of which would be allotted to Gosport for work at that base, the remaining two sections being at Portsmouth: one of which would be available for assisting evacuation from railheads.

Motor Hygiene and Pathological Laboratories.—One of each posted at the base.

Sanitary Sections.—One sanitary section at the base with a sanitary squad at each railhead. These are in addition to the Sanitary sections employed in divisional areas.

Hospital Ships.—Three hospital ships of 700 beds should be available at Portsmouth.

Casualty Clearing Stations.—Two at West Meon, one at Petersfield; all open on evening of February 10.

Preliminary Remarks on the Appreciation.

After the receipt of Corps Orders issued at 20.00 hours on the evening of February 11, the D.D.M.S. was asked for a medical appreciation for the next day's fight. He was required to appreciate a "situation" occurring during the course of ordinary military operations, with the object of informing the Commander—to what extent:—

(1) The heavy casualties sustained that day would immobilize the field medical units, and so militate against an advance on the morrow.

(2) The general medical organization of the Force was affected by the great influx of wounded.

The D.D.M.S. had an interview with the Commander of the Force in the afternoon of February 11 at 15.00 hours, and informed him that the collection and evacuation of wounded was proceeding satisfactorily, though there were still large numbers to be dealt with.

The Commander then asked for an appreciation of the medical situation by 22.00 hours that evening; in the meantime Corps Orders were issued for the expected engagement on the following day.

Appreciation of the Medical Situation on the Evening of February 11.

From the Corps Orders received at 20.10 hours to-day it is intended that the advance will be continued to-morrow morning.

The casualties of yesterday—10th—were only 500; of these, about 100 were killed or died on the battlefield, and were collected and buried there; and 50 died in the main dressing stations of the 1st and 2nd Divisions.

The number remaining, viz., 350, were with the exception of fifteen unable to be moved at the time, evacuated by No. 1 M.A.C. and the lorries detailed for walking wounded, to the casualty clearing stations at West Meon and Petersfield, and thence transferred by ambulance trains to the general hospitals at Portsmouth and Gosport.

The casualties reported to-day, according to returns received, number 3,700. About 700 of these perished on the battlefield, and the two companies of combatant troops detailed by the general officer commanding 3rd Division—in reserve—have been engaged since 18.00 hours in burying the dead and collecting the wounded. Eighty prisoners of war captured before noon were also employed till 17.00 hours as stretcher bearers.

The bearer companies of the 7th, 8th and 9th Field Ambulances, held in reserve, have been assisting the field ambulance bearers of the 1st and 2nd Divisions since 14.00 hours, and all available motor ambulance cars of the three divisions have been employed in the evacuation of wounded from the advanced to the main dressing stations.

Of the 3,000 (approximately) wounded that require collection and evacuation to the casualty clearing stations, 600 have been dealt with by lorries clearing from the Divisional W.W.C.S.'s direct to Nos. 1, 2 and 3 casualty clearing stations at West Meon and Petersfield, and dispatched from there by rail in passenger coaches to the base.

The chief difficulty has been in dealing with the remaining 600 "lying" and 1,200 sitting cases, but the evacuation from the advanced dressing stations to the main dressing stations has been facilitated by the provision of an ample transport service, viz., 100 motor ambulance cars, 40 ambulance wagons, and 25 lorries which were at the disposal of the two A.D.'sM.S. and the Senior Medical Officer of the Cavalry Brigade.

The evacuation, from the main dressing stations to the casualty clearing stations, was carried out by the 100 motor ambulance cars and the twenty-five lorries at my disposal, which included No. 1. M.A.C. and one section of No. 2 M.A.C. brought up from the lines of communication. This evacuation has been steadily maintained throughout the day and evening.

The last reports from A.D.'sM.S. of Divisions, received at 20.30 hours state that all field ambulances are clear of both wounded and gassed cases, with the exception of two mixed groups of thirty unable to be moved. It is proposed to leave a medical officer with sufficient R.A.M.C. personnel and surgical material to deal with each of these. They will remain until the patients are considered fit for transportation to the casualty clearing stations.

The field ambulances are now closing and will be ready to move by 06.00 hours to-morrow.

The three ambulance trains, two at West Meon and one at Petersfield, have been regularly employed in the conveyance of wounded from the casualty clearing stations to the base hospitals at Portsmouth and Gosport. It is therefore to be expected, from reports received from railheads, that the casualty clearing stations will be practically clear of casualties at or soon after midnight 11-12th.

The ordinary daily sick, viz., 3 per 1,000 of the Force, have been sent down the line with the battlefield casualties. It was possible to evacuate most of these on the evening of the 10th by issuing instructions for regimental sick parades to take place soon after the fighting was over on that day. This arrangement reduced the numbers reporting sick on the morning of the 11th, easing thereby the evacuation situation for that day.

Owing to the necessity for a rapid transfer of all casualties in the

casualty clearing stations to the base, the surgical teams sent up from the general hospitals at Portsmouth and Gosport confined their work to the performance of emergency operations.

The 1,000 enemy wounded in our hands have been disposed of as follows: After receiving surgical attention and food, those seriously wounded have been handed over to the local medical authorities for disposal. Those slightly wounded have been placed in custody with ordinary prisoners of war, and arrangements made for their daily attention by the medical officers in charge of Prisoners of War Detention Camps.

The A.D.'sM.S. have been instructed to replenish their field ambulance stocks of medical and surgical requirements, including anti-tetanic sera, from the advanced depot of medical stores at West Meon. This depot is requisitioning the base depot of medical stores at Portsmouth in order to meet all further demands.

The divisional medical units are now ready to move, and have their stocks of clothing blankets and stretchers renewed.

It now remains to consider any further medical arrangements that may be necessary, and what additional hospital accommodation is required at the base, to meet the casualties of the morrow.

The motor ambulance cars already mentioned—100—and the lorries—50, besides 15 motor 'buses, are at my disposal, and will be utilized as required.

The casualty clearing stations will be clear soon after midnight, and arrangements have been made with the R.T.O. at West Meon to have the three ambulance trains available by 12.00 hours on the 12th.

The hospital ships have begun to function, and on February 10 transported 1,400 casualties from the base hospitals at Portsmouth to the Home Country.

In addition to the general hospitals already open, which provide a bed accommodation for 3,600 patients, orders have been issued to have ready the two remaining 1,200 bedded hospitals. This augmentation will meet all likely requirements for the present, and there yet remains one general hospital of 600 beds at my disposal.

The R.A.M.C. casualties, officers and men, have all been made up by reinforcements from the base.

Conclusions.

I am, therefore, able to report that :—

(1) The field ambulances and casualty clearing stations are practically clear of sick and wounded.

(2) The motor ambulance (M.A.C.) and lorry transport at my disposal should suffice for the evacuation of all probable casualties.

(3) The ambulance trains will be ready at railheads.

(4) The medical and surgical requirements of regimental units, field ambulances and casualty clearing stations are satisfied.

(5) There is ample bed accommodation provided in the general hospitals at the base to meet casualties.

(6) The hospital ships are now making regular cross-channel trips with sick and wounded.

(7) The moral of sick and wounded admitted to field medical units has been good.

Headquarters,
Southlands Force.
21.00 hours, February 11, 1923.

Sd. B. Y. Order,
Colonel, D.D.M.S.,
Southlands Force.

SITUATION No 1.

(1) The 3rd Division moved off at 08.00 hours through the outposts of the 2nd Division as follows: 7th Brigade group by the Bordon—Farnham Road; 8th Brigade group by the Alton—Farnham Road (these two brigades finding their own advanced guard); 9th Brigade group in Divisional Reserve, and following the 8th Brigade group; divisional headquarters were to be established in turn at East Worldham and Binsted; the Cavalry Brigade moved on Odiham.

(2) At first no resistance was encountered until the line Pt. 374 (Alice Holtwood)—Lower Froyle was reached, when enemy covering troops were met. The resistance gradually stiffened until the advanced guards were at 12.00 hours definitely brought to a standstill on the line Wrecclesham to Roman entrenchment (1½ miles S.S.E. of Crondall).

(3) The Divisional Commander ordered a concerted attack by the 7th and 8th Brigades to take place at 14.00 hours with a view to capturing the high ground, Hungry Hill—Beacon Hill; while the 1st Division secured the western end of the Hog's Back.

The 1st Cavalry Brigade was instructed to operate through Crondall towards Aunts Pool Hill.

The 7th Brigade group had by 12.00 hours suffered some 200 casualties, and the 8th Brigade group fifty.

The Cavalry Brigade (which was placed for medical purposes under 3rd Division) had reported eighty casualties, mostly in the neighbourhood of Long Sutton.

Required:—

(1) Assumed positions of the medical units of 3rd Division and Cavalry Brigade at 12.00 hours.

(2) Orders or instructions given to these units by you as A.D.M.S., 3rd Division.

A G.O.C.'s Conference was held at Corps headquarters, Petersfield, at 16.00 hours on February 11. It was then stated that the enemy was falling back in a north-easterly direction, and was not expected to be met in strength before the forenoon of the following day—12th.

The proposed Corps medical arrangements for the 12th were detailed

by the D.D.M.S. and discussed, and it was arranged that "Q" should place at his disposal thirty lorries obtained from the reserve mechanical transport companies, and that they should be "fitted" for walking wounded cases.

The D.D.M.S. held a conference of A.D's.M.S. of divisions and the Officer Commanding Cavalry Field Ambulance at Petersfield at 18.00 hours, February 11. The general situation and medical arrangements for the 12th were discussed, and it was decided that the A.D.M.S. 3rd Division should establish a divisional M.D.S. and W.W.C.S. at Binsted by 09.00 hours on that day for the reception of all casualties of the division, plus those of the Cavalry Brigade. The D.D.M.S. stated that he would issue instructions for twenty-five cars from No. 1 M.A.C. and ten lorries for W.W. to report to A.D.M.S. at 3rd Divisional headquarters by 08.00 hours on 12th for evacuation of casualties to casualty clearing stations at West Meon. The cars and lorries to be returned to convoy headquarters on completion of duty.

At 20.50 hours on February 11 the A.D.M.S. 3rd Division was present at his G.O.C.'s Conference at West Meon.

The 3rd Division operation orders were issued at 22.00 hours on February 11 and contained the following:—

* * * * * *

(8) The Divisional M.D.S. and W.W.C.S. will be established at Binsted by 09.00 hours to-morrow.

The A.D.M.S. 3rd Division held a Conference of Field Ambulance Commanders and Officer Commanding Cavalry Field Ambulance at 21.50 hours February 11, after General Officers' Commanding Conference at West Meon, and the following orders were issued:—

SECRET. COPY NO., FEBRUARY 11, 1923.

3RD DIVISION ROYAL ARMY MEDICAL CORPS ORDERS, NO. 2.

Reference O.S. one-inch map, Aldershot Command.

(1) Enemy is falling back in a north-easterly direction.

(2) 1st and 3rd Divisions and Cavalry Brigade will advance at 08.00 hours to-morrow.

(3) The Division will secure the line Farnham—Aldershot and the high ground about Cæsar's Camp—Hungry Hill.

(4) The Divisional M.D.S. and W.W.C.S. will be opened by No. 9 Field Ambulance at Binsted, for the reception of all casualties of the Division and Cavalry Brigade.

(5) Twenty-five cars from No. 1 M.A.C. and ten lorries for W.W. have been placed at the disposal of A.D.M.S. to convey cases from Binsted to casualty clearing station at West Meon. Cars and lorries to return to convoy headquarters on completion of duty.

(6) No. 7 Field Ambulance will conform to the movements of 7th Brigade.

(7) No. 8 Field Ambulance will conform to the movements of 8th Brigade.
(8) Cavalry Field Ambulance will follow Cavalry Brigade.
(9) Reports to Divisional headquarters at Wyck after 10.00 hours.
(10) Acknowledge.

Sd. A. N. Other,
Colonel, A.D.M.S.,
3rd Division.

Despatched by S.D.R.
at 22.30 hours.

Copies to:—

7th F.A.	...	No. 1.
8th F.A.	...	No. 2.
9th F.A.	...	No. 3.
Cav. F.A.	...	No. 4.

For information:—

7th I.B.	...	No. 5.
8th I.B.	...	No. 6.
9th I.B.	...	No. 7.

For information:—

"A" and "Q"	...	No. 8.
"G"	... ...	No. 9.
A.P.M.	... ...	No. 10.
A.D.M.S. 1st Div.	...	No. 11.
D.D.M.S. Corps	...	No. 12.
File and War Diary		Nos. 13 and 14.

(*To be continued.*)

HABITS, CUSTOMS AND MODES OF LIFE OF THE NATIVE TRIBES OF BRITISH EAST AFRICA (NOW KENYA COLONY).

BY CAPTAIN R. L. STANLEY, M.B.E.

(*Continued from p.* 38.)

THE LUMBWA.

THE habits and customs of the Lumbwa very much resemble those of the Nandi in every respect. They are practically next-door neighbours to the Nandi and inhabit the higher and mountainous country south of the equator and east of the Victoria Nyanza, whilst the Nandi country lies to the north of the equator with the north Kavirondo country on its west. The Lumbwa country is excellent for stock raising and agriculture, both of which pursuits are followed by its people.

The women of the tribe are fond of decorating their arms and legs with strands of iron wire, the limbs being enveloped so tightly as to press most uncomfortably into the flesh. The ears are pierced as in the case of most of the East African tribes, and the usual pendants vary from a skewer of wood or iron to an ointment- or jam-jar a few inches in diameter. As in the case of most tribes the women carry heavy loads and till the soil while the husbands idly lord it over all.

The dwellings are the usual circular huts built of sticks, mud and cow-dung, without light or ventilation and roofed with grass. The tribe, however, does not congregate in villages as do most others, but is scattered in small allotments of family groups, each family occupying one or more huts. When the children grow up they go and live in the cattle boma. The cattle are gathered together in a kraal for the night, but calves, goats, sheep and fowls are housed in the dwelling huts with the people, the hut being divided into sections for all parties.

The foodstuffs produced and consumed are wimbe, maize, beans, sweet potatoes and various vegetables. The customary meals are in the morning and evening with a light meal at mid-day. Porridge is made by putting wimbe flour into boiling water and is partaken of night and morning; a mere liquid porridge is taken at midday. The males eat apart from women and children and the food for all is the same. There is very little variation in the dietary. No food is forbidden, but a man who has eaten meat or beans is not permitted to drink milk for some time. The principal drink after, or with meals, is water, and it is the custom to wash before meals. Food is stored on a shelf in the hut.

Intoxicants are made from wimbe or maize mixed with water and allowed to ferment. The beverage is usually sucked through tubes and is

FIG. 7.—Two Girls—Lumbwa.

FIG. 8.—Two Boys—Lumbwa.

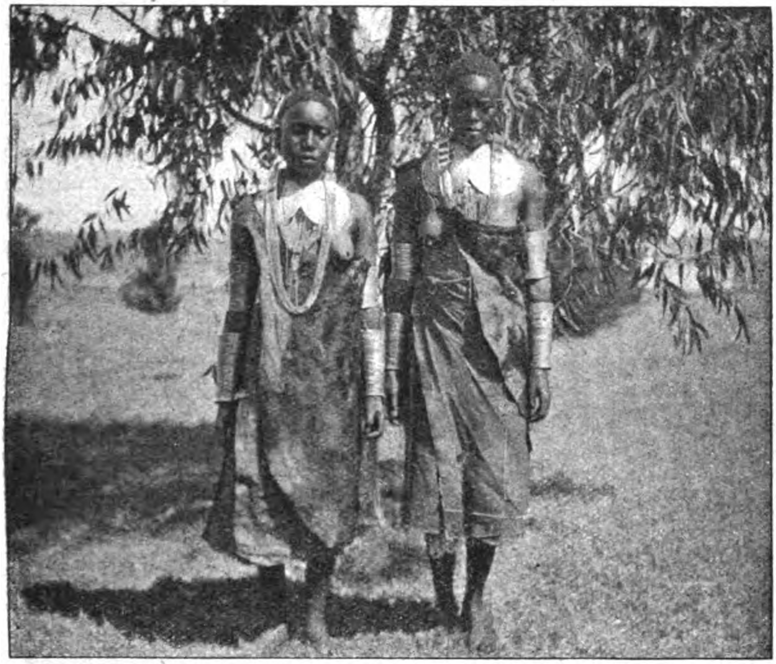


FIG. 9.—Wa-Taita Women.

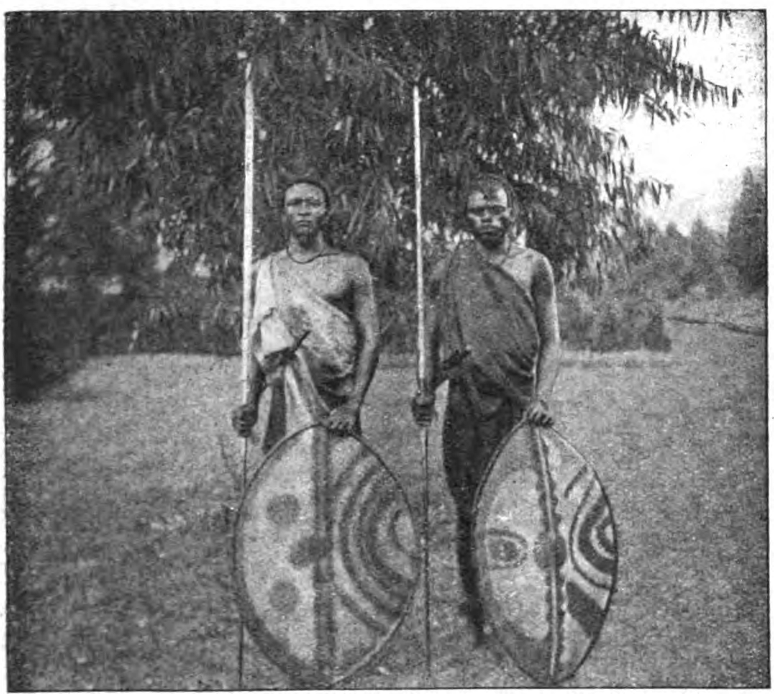


FIG. 10.—Two Warriors—Lumbwa.

taken on all festive occasions of circumcision, births, funerals, etc., besides being given as payment for help in tilling the soil.

The usual primitive sanitary arrangement of adjourning to the bush and consigning all refuse there is resorted to, and a powerful sun acts as Nature's disinfector and deodorizer. In other climes there would be a very sad story to tell, but here in Africa this bounteous protection of Nature permits the aboriginal of tropical lands to consciously or unconsciously disregard the laws of cleanliness and sanitation. No doubt there is a toll, both in health and longevity of life and a big infantile death-rate; but considering the neglect of sanitation this is not so great as would be expected except when an epidemic occurs.

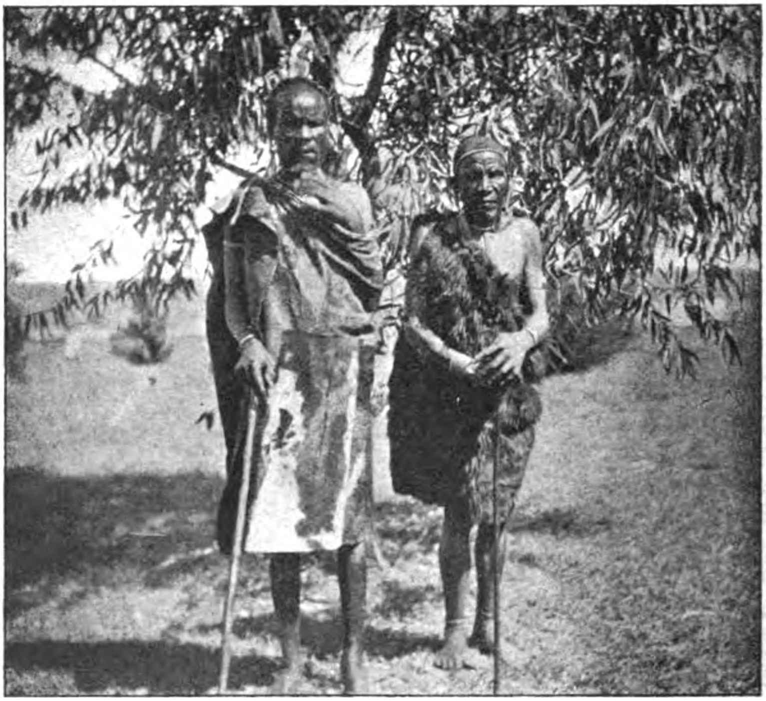


Fig. 11.—Two Old Men—Lumbwa.

This tribe is not provided with the usual establishment of medicine men and as a rule knows little about medicines. This may be due to the fact that these gentlemen were deported some years ago and the profession has lost popularity in consequence. They regard the Nandi as the medicine men.

No system of religion or theology prevails, and there is very little idea of an after-existence. Some believe in the malign influence of the shades of the departed, and propitiatory offerings are made, as in the case of the

Nandi; and as is also the custom of this latter tribe, the Lumbwa bury the old men and young children, whilst other deceased members are thrown into the bush to be eaten by hyenas. The nearest relatives go into mourning for the departed and remain in seclusion for a few days, when their heads are greased and shaved.

The race may be regarded as fairly fertile, the number of children averaging about three to each wife. This may be due to the fact that medicine men are not common and do not practise their art to any great extent. At any rate neither abortion nor anti-conception measures are practised, as is the case in other tribes, and women do not often die in childbirth. Children are nursed sometimes for two years, and the women are excused work for a month before and after birth. The tribe is possessed of a good physique generally and contributes a goodly number of recruits to the defensive forces of the Crown in addition to the agricultural and labour markets.

THE MARAKWET.

The Marakwet, the Elgeyu and other sub-tribes and clans inhabit the country to the east of Mount Elgon known as the Turkhana. At the present time there is not much information regarding these peoples obtainable, and beyond a few Government stations there has been as yet no European settlement. The few notes here given regarding the customs of the Marakwet may, however, be regarded as more or less descriptive of the other tribes living adjacent to them in these regions.

Each Marakwet with his family has a separate boma (enclosure). There are no villages, but, not infrequently, bomas are no great distance from each other. Each man has a hut for himself besides one for each of his wives. Small children live with their mothers, but boys at the age of 14 generally build themselves a separate hut in their father's boma; as soon as they become married they build a separate boma altogether. Occasionally a man will keep his mother or his wife's mother in which case he usually builds them a separate hut inside his boma. Huts are circular but have no centre pole. The walls are made of small poles placed upright close together with their ends let into the ground about six inches. These walls are mudded and cow-dunged on the inside only, the roof which slightly projects over the walls being well thatched with grass. The huts vary from eight to twelve feet in diameter, and are approximately twelve feet high at the apex—the circular wall being four to five feet high from the ground to the eaves. The huts have ceilings at the height of the wall, these being made of sticks criss-crossed; the space thus formed between the ceiling and apex of the roof is used for storing cooking pots, water mitungis, spears, etc. The ceiling is supported by a centre pole.

Huts are ventilated by a small opening which serves for a door, occasionally very small holes being made in the walls for light and ventilation.

The groups of huts are invariably built on spaces levelled out from the side of the escarpment; the lower lip of the platform thus made is supported by boulders. A space of about fifteen to twenty feet is usually left between the huts to guard against fire spreading from one to the other.

Sheep, goats and young calves sleep in the hut of the male owner of the boma. He will not allow them to sleep in his wives' huts as he is

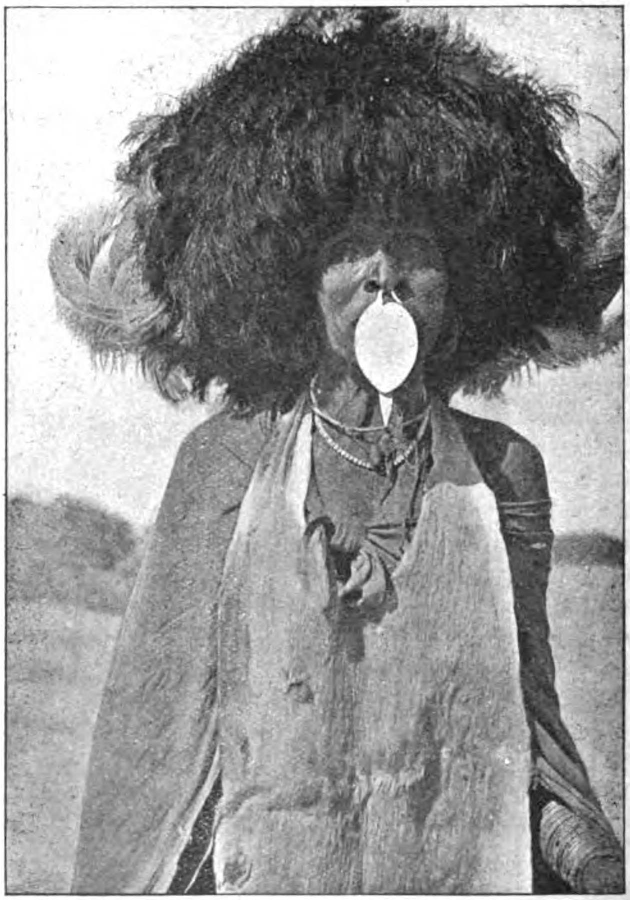


FIG. 7.—Native Chief.

afraid the wives might kill them should the animals tread on the babies. The rest of the cattle sleep outside the huts but inside the boma. Poultry are not kept.

Food is stored in special store huts which vary considerably in size, being from three feet to seven feet in diameter. There may be any number of such huts from one to five in each boma and the pattern is generally the same.

The main food is wimbi flour supplemented with honey, wild vegetables, milk, bullock's blood, and very occasionally meat (goat, sheep or bullock). There are no fixed hours for meals, but usually a meal is made in the early morning and again about sundown. When food is abundant a large lump of cooked wimbe flour is carried to be partaken of at whatever work they may be engaged on during the day. Food is cooked in earthenware pots (made locally of blackish clay), separate vessels being used for different foodstuffs. The nature of the food seldom varies. Honey is taken about January and February in the valley, and in September on the top of the escarpment. Men, women and children all eat together and there is no essential difference in the food consumed by the young or old of either sex.

An intoxicating drink is made by putting honey together with its wax into a cooking pot with a strip of the outside of the seed pod of a tamarind tree. The cooking pot is suspended a good distance above a fire and allowed to come to the boil slowly, after which the liquid is strained off. It is stated that honey will not boil at all unless it has a strip of the seed pod of the tamarind in it.

This drink is consumed in large quantities at all wedding parties and at large meetings of chiefs and old men; at other times it is seldom drunk. There are certain members, however, who have a craving for the intoxicant, and these drink in solitude or with a bosom friend, but even so they seldom have a debauch more than once or twice a month. The liquor does not apparently do much harm, and delirium tremens is unknown.

The Marakwet are certainly extremely frightened of disease and have an instinctive knowledge of the way to avoid malarial fever, which is evinced by the fact that no Marakwet will ever be found in the valley after dark, where mosquitoes abound during the wet season. The custom is, when a disease like smallpox presents itself, to isolate all who contract the disease and their families, and these people are not allowed to leave their quarantine under any pretext, whilst all visitors are warned off. The food of the sick person is cooked by his family and left just outside the door of his hut. Should the patient die, someone who has already had the disease and recovered goes into the hut and attaches a rope to the corpse which is then dragged into the bush and left there for the hyenas to dispose of. The hut is not used again, nor is it burnt, but merely left to rot away.

There are native medicines for most ailments, but it is extremely difficult to find out what they are compounded from as the secret is zealously guarded by the few who know. The secret is handed down from mother to daughter and more rarely from father to son, and is thus kept in families. The persons who know these medicines for the more common ailments, although they are treated with the greatest respect, have little influence on the whole and do not take any prominent part in ceremonies.

There is, however, another class of medicine man, but the number is very small, who certainly have an influence and are held in great respect

and awe. They deal with the more serious problems such as the casting out of evil spirits, madness, and with all questions bearing on childbirth, etc. These medicine men do not overstep their particular sphere and are readily controlled by the chiefs.

The only theology recognized is that the sun is God and to it they pray. The spirits of the departed also play a great part in their lives and are the cause of almost every illness or misfortune and, in rare cases, of happiness. Hence they are constantly prayed to and appeased. All fits of whatever description, epileptic, etc., are attributed to the evil influence of some departed spirit of an ancestor. Thus should a man be seized with a fit he is held down and covered with a blanket, the edges being held down to the ground to prevent the fumes escaping. Whilst the patient splutters and coughs, he is roughly shaken and repeatedly asked whose spirit it is that has entered into him and what does it want.

The unfortunate individual invariably mentions the name of some relation who has died and says that the spirit wants a goat or sheep killed to appease it, which is done.

Only old men and women whose hair has turned grey are buried. Little ceremony is attached to burials. A male relation usually carries out the corpse and takes it to a spot in the bush, some 200 yards or more from the hut, and there buries it in a shallow grave. All others when they die are merely carried out and placed in the bush where they are devoured by hyenas.

A widow is made to shut herself up in her hut for a month following the death of her spouse, but there are no restrictions on other relatives.

The severe rains experienced in these regions annually cause the death of numbers of old men and women as a result of colds and pneumonia.

No views of an after-existence are entertained except that the spirits of the dead hold continual communion with the living and keep guard over them, but more often see fit to punish them by misfortune and illness.

The birth rate of the tribe is said to be fairly good, but actual figures are not obtainable and the hut census for tax purposes is not reliable. Infant mortality is stated to be small and female births predominate. Anticonception or abortion measures are extremely seldom practised, but a certain kind of medicine is known which causes abortion. Few deaths take place in childbirth, and children are usually nursed for a year or more. Artificial feeding is practised should the mother die or be taken ill; cow's or goat's milk is given diluted with water. Foster-mothers are absolutely debarred. The period of lying-in is usually about a week, and the second wife, or, failing her, a young girl neighbour, usually attends to the patient.

(*To be continued.*)

Clinical and other Notes.

A CASE OF TRAUMATIC PERFORATION OF THE JEJUNUM. OPERATION. RECOVERY.

By Major E. L. FYFFE.
Royal Army Medical Corps.
Surgical Specialist, 21 *Stationary Hospital, Kilia, Turkey.*

Stoker M.D., Royal Navy, admitted to hospital on November 26, 1922. The notes by his medical attendant on the case are quoted below in full as they bring out several points of interest :—

"This rating reported at sick bay at about 6.10 p.m. this evening November 25, complaining of severe abdominal pains due to a 'punch' in the abdomen by another man's knee whilst playing football at Smyrna on the afternoon of the 25th instant. He said that immediately after the accident he felt severe pain which, after rubbing the abdomen, was sufficently lessened *to allow him to carry on playing for some minutes.* He said that immediately after the match the pain became again severe, *but he was able to walk to the boat, a distance of more than a mile.* In the boat the pain was still bad. When he got on board he wanted to pass urine, but could not, and later the desire to do so passed off. When seen at 6.20 p.m. he was considerably shocked, pale and restless. He lay on his back, knees drawn up; abdomen not distended; muscles (abdominal) very rigid: liver dullness normal; pain general over umbilical region but worse in hypogastrium. He also complained of pain across lumbar region. Temperature 97°. *Pulse 80,* regular, small volume. He was placed in bed, hot boric fomentations were applied every hour. Urine drawn off per catheter 14oz., normal, did not contain blood. As he still complained of severe abdominal pain and vomited once at 8.45 p.m., a consultation was held with the medical officers of the Dutch ship T., and the French ship E. R., as to the advisability of an immediate exploratory laparotomy.

"Having examined the patient (i.e. at 9.30 p.m.) these officers were of the opinion that, under all the circumstances, operation might be deferred pending his removal to hospital. At 1 a.m (November 26) he passed urine normally. Abdominal pain continued and stupes were applied to the abdomen every hour. He was given hypo. morphia, ½ grain, after which he slept restlessly for a few hours.

"This morning (November 26) 7.30 a.m.: *Pulse 120,* of good volume. Abdomen still rigid, not distended, breathing easier. 10 a.m. and 2 p.m., strychine hypo. 1/50 grain. I beg to forward him for treatment."

The following are my notes on the case :—

"This rating was admitted to hospital at 5.30 p.m., on November 26, 1922. *On admission* he was extremely collapsed and semi-conscious; face

drawn and pale; lying in bed with his knees drawn up; pulse not perceptible at all. Temperature 97°. Respiration shallow, rapid and entirely thoracic. *Abdomen*: No movement with respiration, moderately distended; on palpation, board-like rigidity all over; tympanitic in umbilical region, dull in both flanks; *liver dullness absent*; no mass felt.

Operation, 7 p.m. Intravenous infusion of saline one pint. Chloroform and closed ether. Laparotomy in epigastric region. Rectus split: on opening peritoneum, which was under tension, non-purulent, straw coloured, free fluid escaped, and small intestine, much distended, bulged into the wound: scraps of food, peas and bits of pork, were all over the abdominal cavity. Jejunum was withdrawn and a recent perforation about the size of a sixpenny piece was found, roughly two feet from the duodenojejunal flexure; this was pouting and discharging partly digested food. The general abdominal cavity was packed off and the perforation oversewn and inverted with Halstead satures; the gut was shining and looked healthy, though there were pieces of yellowish lymph here and there on its surface. Abdominal toilet was performed and further perforations looked for, but not found; a tube was put down to Douglas' pouch and the abdominal wall united in layers. Pulse now perceptible 130. Pituitrin 1 c.c.

The man's condition remained desperate for forty-eight hours, when the tube was removed: he was put on pituitrin injections and rectal saline: his convalescence was slow owing to the development of a small fæcal fistula, but this healed after two months, and he was discharged to the Naval Hospital, Malta, by hospital ship, as a walking case.

The interest in this case obviously lies in the length of time elapsing between the receipt of the injury and operation, namely, twenty-seven hours. In a clinical lecture on "Subcutaneous Rupture of the Intestine," given at Guy's Hospital on March 7, 1923, Mr. R. P. Rowlands, M.S., F.R.C.S., gives the following figures:—

		Mortality
Operation within	4 hours	15·2 per cent.
,, ,,	5—8 hours...	44·4 ,,
,, ,,	9—12 hours	63·6 ,,
,,	later	70 ,,

These figures are taken from a series of 376 operation cases.

There seems to be no reasonable doubt that the injury this man sustained ruptured his jejunum at the time, and it is therefore all the more amazing that he continued playing football and walked over a mile to his ship. There was no trace of bruising or injury to the abdominal wall, and this is quite in keeping with one's previous experience of such cases.

Clinically the most important feature is the gradual increase of pulse-rate as the result of the onset of peritonitis—in this case the pulse-rate rose from 80 to 120 in a few hours; this, taken in conjunction with the loss of liver dullness and the intense *early* pain, at first local and later general, gives one a typical picture of the rupture of the intestine.

Mr. Rowlands, in the lecture quoted above, gives the following figures for the site of the rupture in 381 cases :—

Duodenum ...	23	Ileum	158
Jejunum ...	157	Colon	43

Bearing these figures in mind, the abdominal incision is preferably made high up and either in the mid-line or slightly to one side of it; after dealing with the perforation, dry abdominal toilet is, I think, the invariable modern procedure. In this case the rupture ran across the axis of the intestine, which is the commonest condition in the small intestine.

I am indebted to Lieut.-Col. F. Ashe, R.A.M.C., officer commanding 21 Stationary Hospital, for permission to publish these notes, which do not profess to be a thesis on the subject, but merely a few remarks on an unusual case. I would add that the patient was nursed entirely in a tent under rough camp conditions, and that all credit is due to the Nursing Staff for their untiring attention to, and skill with the case.

MEDICAL (WAR) RECORDS.

BY DIRECTOR OF STATISTICS.

Ministry of Pensions.

It was always an irksome duty to make up records or returns when medical officers had so many other duties to fulfil, the importance of which was so much more evident. Where were these returns going? Who has asked for them and who would ever take any interest in them?

It must be a great satisfaction to those who spent part of their time in making entries in the hospital admission and discharge books, and after 1916 writing up the individual medical record card, that the results of their work are now being used for the benefit, not only of medical science, but of the ex-service man himself. All admission and discharge books and medical record cards in use wherever medical treatment was given, at home or abroad, in casualty clearing station, base hospital or one of the large hospitals at home, have been collected and arranged so that there is now under one roof a medical index for every service man who received treatment during the war.

Up to the end of 1915 the medical records consist of the admission and discharge books. In 1916 the Medical Record Card was instituted and carried on thereafter until the end of the war. The medical record cards have all been arranged by regiments, and regimental numbers. Each entry in the admission and discharge books prior to the introduction of the medical record card has been transferred to a card giving particulars at each stage of treatment and filed in the medical record card index, so that now there is a complete card index in regimental order giving the details of every man treated for wounds, disease or sickness contracted during his service. It therefore will be seen that most men may have more than one card and in fact in certain cases men have as many as twenty or thirty cards relating to their medical history during service. Having collected and arranged this enormous card index the purposes and ideas of those

who were responsible for the introduction of the medical record card are now being given effect to, and information under the following different broad headings is being furnished in detail:—

(*a*) Medical History of the War; (results of special military operations and actual effects of introduction of new methods of warfare).

(*b*) Medical Research; (as applicable to medical science).

(*c*) Individual medical histories in connexion with claims for war disability pensions.

During the course of the war the suggestion occasionally arose that the importance and value of medical records were exaggerated by the official mind, and that the volume of medical notes and case-sheets which they were required to maintain was labour useless in itself and likely only to be consigned to dusty oblivion. There were memories of the medical records of the South African War which lay for so long in inglorious darkness in the vaults of the War Office; there was the often openly expressed criticism, "We are here as medical men, not as clerks, and our business is to heal bodies and not to drive pens." In fine, the attitude of very many medical men in this country was hostile to mere "statistics," averse to maintaining accurate notes of their cases, and wholly sceptical as to the use these notes were to be put to if they were maintained. But the sequel will show that their efforts were not to be wasted and that they played a very important part in our national economy.

In November, 1914, the Medical Research Committee (which became the Medical Research Council on April 1, 1920) offered to place their resources at the disposal of the War Office for medical statistical purposes. The offer was accepted by the Army Council, and the collection of statistics from the sick and wounded from the Home and Expeditionary Forces was immediately begun, while at the same time arrangements were made and ultimately carried out (so far as concerns the years 1914 and 1915) by the Medical Research Council for the analysis of these statistics with aid of the most recent mechanical methods. Before, however, the actual extraction of the statistics could be commenced, the material had obviously to be collected and arranged. At first the Medical Research Council organized the copying of all U.K. Admission and Discharge Books in the hospitals themselves, but the expense of that device proved excessive, and in May, 1916, every hospital in the U.K. was directed to maintain its own card index, which eventually came into the hands of the Medical Research Council along with similar cards (A.Fs.W.3162 and 3118, the Field Medical Card) which were maintained in France and Flanders. Concurrently with these were forwarded case-sheets and A. and D. books from hospitals in all theatres of war. Material began to accumulate literally by the ton, and by the end of the year 1920 the hospital cards alone in possession of the Medical Research Council weighed about 210 tons.

In making this collection of records, the Medical Research Council had seen from the first that it would serve three purposes:—

(1) It would constitute the basis of the Medical History of the War; (2) it would supply the largest mass ever brought together of miscellaneous medical material available for scientific research; and (3) it would provide assistance not obtainable elsewhere for the proper settlement of claims to pensions or allowances, which would arise immediately after the war, and long after the war

among civilians who might attribute their ill-health to a war casualty. This expectation has been amply fulfilled, and there is now housed under one roof, under the charge of the Ministry of Pensions (to whom the Medical Research Council handed over its work and accumulation of records in February, 1921) a card index and a collection of records, which, on the principle of arrangements as originated by the Medical Research Council, and continued by the Pensions Ministry, contains records of every disabled soldier. Briefly, the great card index, now amounting to some 30,000,000 cards, is arranged in regiments and in order of regimental number, or for officers alphabetically. Each entry in the admission and discharge books has been carded (if no hospital card exists for the man in question), and each man's cards—sometimes over twenty in number—are brought together, and these constitute (with his case sheets, if the character of the illness warranted a case sheet) a complete medical history of his military service.

From what has been said above, it can be gathered that the main credit of this stupendous work is due to the Medical Research Council, who initiated and organized the work of the collection of statistics, who laid down the leading principles of their arrangement, who completed the major part of that arrangement, and who completed also the codification of the statistics for the years 1914 and 1915. To the work of that body the Ministry of Pensions has been the heir, and as such has been put in possession of information which enables them to adjudicate entitlement to pensions on the one hand, and enables the claimant to substantiate his claim on the other. In this connexion it may be mentioned that during the first six months of this year 25,000 queries on claims have been answered, and the arrangement of the records is such as normally to enable all queries to be answered within forty-eight hours.

The index at last collected and arranged, the purpose and ideas of those who made this collection are now being given effect to, and information under the following broad headings is being furnished in detail:—

(*a*) Individual medical histories in connexion with claims for disability pensions. (This, the most important feature from the point of view of the Pensions Ministry, has already been dealt with).

(*b*) Medical History of the War (results of special military operations and actual effects of the introduction of new methods of warfare).

(*c*) Medical research and investigation.

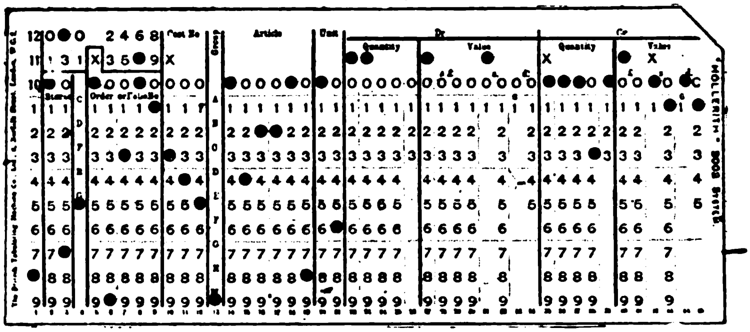
In connexion with (*b*) the information in the collection can supply the effect of treatment on casualties and sickness as affected by military operations, e.g. the number of admissions from disease as distinct from wounds during the Gallipoli campaign, or the number of men sick, wounded and gassed, admitted to certain casualty clearing stations during the second battle of Ypres.

In connexion with (*c*) information is being extracted and collected under the supervision and with the advice of the Medical Research Council, and detailed tables are being prepared, giving the average number admitted to hospital, days off duty, results such as deaths and invalidings from the Service, average constantly sick from disease, wounds and injuries, and under these or similar headings the ratio per thousand of the respective strengths.

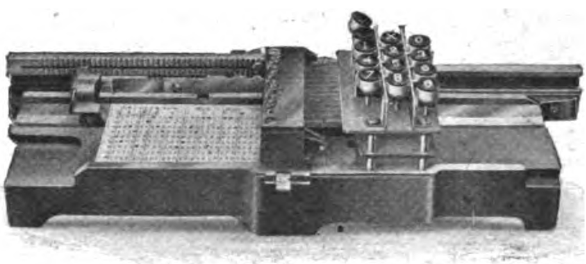
While the work in connexion with (*a*) consisting of a thorough examination and extraction of information regarding an individual case can only be done by

personal labour, it would be practically impossible to obtain all that is required in (*b*) and (*c*) by such means. With them there are so many different types which have to be arranged according to one or other feature of the case that, if left to manual sorting, the task would be almost hopeless. For instance, the incidence of wound and diseases must be shown according to the theatre of war, the arm of service and regiment. The medical effect according to the age, rank and service, type of wound or disease, nature of operations, etc., and the number of days off duty, and the final result of the treatment.

It is, therefore, necessary to adopt mechanical means to extract and tabulate the enormous fund of information contained in this index of over 30 million cards. This is effected by translating the information contained on the hospital card into



Hollerith Card.



Punching Machine.

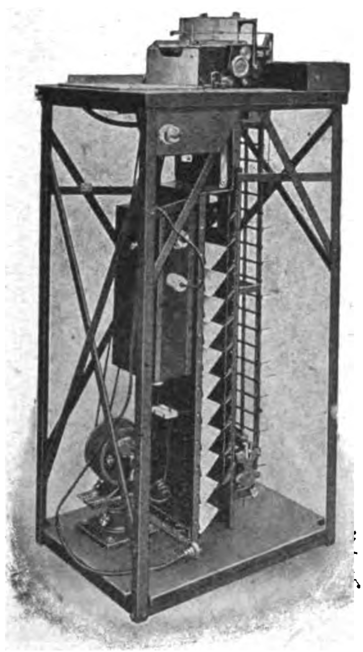
a numerical code. For instance, the forces operating in France are: Field Forces, – 1, those in Salonica – 4. Similarly a warrant officer is ranked – 1, a serjeant ranked – 2, and so on for each type of information.

This code information is then recorded on a special card. This card, which is the basis of the mechanical tabulation, is ruled into forty-five vertical columns. Each column contains a row of figures 0 to 9. To every main heading a certain number of these columns is allotted according to the number of variations under that heading. For instance, one column is sufficient for the field forces because there were less than ten field forces. One column is sufficient for rank because there are less than ten different ranks, whereas three columns are

required for the disease code because there are over 100 diseases distinguished and therefore three numerals are necessary.

The method of recording this information is by punching holes in the figures of the special card according to the numerical code. The punching of these cards is done by a machine similar to a typewriter except that instead of a figure being printed a circular hole is cut in the correct space.

To make certain that the cards are correctly punched they can be checked by a special machine called a "verifier." This machine is exactly similar to the punching machine except that instead of the keys operating a circular cutter they actuate a blunt plunger. The card to be checked is placed in the machine and the operator proceeds to re-punch the information; if the card has been correctly



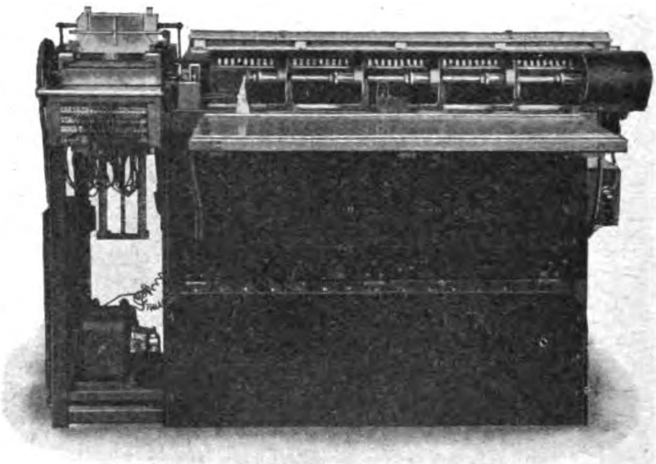
Sorter.

punched the operation goes on without a hitch, but should the hole in any column not be in the correct space the blunt plunger is stopped, the operator cannot depress the key and knows at once there is an error. As this plunger leaves a distinct impression the position of the error is at once apparent. These punching operations demand care, but after a little training 300 cards can be punched by each operator in an hour.

When they are checked and passed correct, the whole of the rest of the work of compilation, every extract of information, is made from these punched cards simply by passing them through electrical machines. They are in the first instance passed through the "sorting machines," by which they are sorted according to the main headings required. For instance, if it was desired to arrange the cards under the different ranks, the cards are fed through a tall sorting

machine, and pass one by one before a magnetic finger ready set in position opposite the column on the card allocated to "rank." If it finds a hole it makes a contact through the hole and opens a pocket numbered according to the position of the hole on the card and into this pocket it falls as it passes down the machine. The sorter can be set to sort out 18,000 cards an hour and separate each into its proper pocket.

From the sorting machine the cards go to the tabulator which does the counting. It can do half a dozen sums at the same time, for it has magnetic fingers which pass over half a dozen columns on the card, and wherever they find a hole they make electrical contact to operate the little adding machine belonging to each division of the card. Thus, having sorted the cards into the different



Tabulator.

ranks, the tabulator will count how many warrant officers, serjeants, corporals and privates received a given type of wound, the number of days they were off duty and the result of the treatment.

To realize the enormous help which these machines give let the reader picture himself in charge of the medical record cards and asked to furnish the number of any given wound, say gun-shot wound of the hip, which occurred to a particular field force, and the results of these. Imagine the number of clerks and the time they would take to go through the millions of cards in the index, pick out all cards relating to men who had served in the Field Force required, select those who had been shot in the hip, and then start to compile how many had died, how many had recovered, how long they had taken to recover, and if they were fit for duty on recovery. Having done this would you be sure your totals were correct? But the machines will do it all in a matter of hours and be correct when the tabulation is complete.

Sport.

SNIPE SHOOTING IN BURMA.

By Major-General Sir WILLIAM PIKE, K.C.M.G.

Early in 1906, when stationed at Mandalay, H. and I arranged to have a whole day's snipe shoot on the Obo Canal, some four miles west of the Fort.

We started off on the evening of January 13, and having arrived at Obo village, got a boat and went up the canal above Tambew village, where we landed and after a little search found good camping ground close to the canal. Our boys soon put up our mosquito nets, and after a hearty supper we turned in.

We were called an hour before daylight, and after a comfortable breakfast, H. and I started to the nearest "paddy" (rice) fields, and as soon as the light permitted we were well into the snipe. The first hour was bitterly cold and the birds very wild: H. managed to get a good many, but I was not shooting up to average. We had six small Burmese boys to pick up and carry the birds and had arranged that they were to be paid according to the "bag." This is an excellent plan in India and Burma and very rarely is a bird lost—the marking down and finding of the dead birds by these small boys is truly marvellous. In those good old days I used to give eight annas for each fifty birds, but I fancy this is far more now.

We shot steadily through the day with occasional rests for sandwiches and cold tea, and on counting up our birds on our return to tea we had a nice bag of 123 couple of snipe and four various.

We returned by boat to Obo and thence by gharry to Mandalay, very tired, very dirty, but very pleased with our day.

The snipe shooting round Mandalay is excellent throughout the months of December, January and early part of February, but the birds do not always go to the same places each year and it is best to find out where they are before "going for" a big shoot.

There are some places which always hold snipe in enormous numbers. I once had a bet with a man who said that snipe *once in* did not move about much. I did not agree and backed myself to kill twenty-four couple of snipe every day for six consecutive days in one small marsh of about three acres. I won by an average of twenty-five couple. The gheel was shot out by each evening and was full of snipe again next morning.

These long days in gheels and paddy fields cannot be undertaken unless one is very fit and well, as the walking is of two classes, both bad, i.e., (1) soft mud or marsh up to the top of the boots or higher; (2) a precarious line of advance on the little bunds between the rice fields,

which are as a rule not more than eighteen inches wide and built up here and there with soft mud which has to be avoided or a fall is certain. (N.B.—After any sort of a fall in soft ground like this, take out your cartridges and *see* that the barrels are clear.)

Burma is a sportsman's paradise and the Burmese most keen. Their jungle huts are usually very clean and I have slept several times in them.

Snipe in Burma or in any hot country are nothing like so difficult to kill as at home, except perhaps during the half-hour or so between dawn and sunrise. H. on the above occasion was shooting superbly, his "pick-ups" amounting to nearly four-fifths of those fired at. He had just come from winning the last Grand Prize at Monte Carlo.

Travel.

THE JENOLAN CAVES.

By Colonel S. F. CLARK.

Probably few people in England have heard of these caves, but they are one of the prides of Australia, and all visitors to New South Wales are expected to see them. The Government Tourist Bureau in Sydney makes the path of the traveller to Jenolan very easy, and for the sum of seven pounds it will take him from Sydney to the caves and back on a five-day trip, will board and lodge him at the excellent Caves House Hotel, and will show him four of the caves. If he wants to see any more of them he can do so by paying the usual fees, two to five shillings per cavern. We did this trip, and I shall try to tell of what we saw, beginning with some words on the journey.

We left Sydney on a Monday by the 9.25 a.m. train for Mount Victoria, the farthest of the holiday resorts on the Blue Mountains. These heights are very dear to the hearts of the city folk, and at Christmas or Easter the number of people who are compressed into a mountain hotel or boarding house is astonishing. The ranges begin thirty miles from the capital, and in the early days of colonization the time soon came when the settlers felt shut in by them. For the progress of the colony it was imperative to get over the mountains into fresh lands beyond where the flocks and the herds could multiply, but for a long time every effort to do this failed, for no white man could find a path across the barrier. The height was nothing —under 4,000 feet—but the precipitous cliffs which bounded the valleys like great walls were unscalable, and man after man was beaten in the attempt to win the reward which the Government at last offered to anybody who could find a passage through the ranges. Even the indomitable Surgeon Bass of the Royal Navy, a man with the soul of an explorer was

completely defeated by this barrier of precipices, and he is reported to have said that no man would ever get through. His name lives in Bass Strait, for it was he who set out in a small boat and found that Tasmania was an island. For ten years all ships making for New South Wales had gone south of Tasmania, as it was believed to be part of the Continent of Australia.

By 1803 the need of more elbow room in the colony was so great that three men, whose names are household words to this day, determined to succeed where so many had failed. They were Blaxland, a farmer from Kent, whose holding was almost at the foot of the hills; Lawson, a lieutenant in the 102nd Regiment, and Wentworth, a local lad who afterwards made his name famous in Australia. Their plan to get over the mountains was to cross no stream, but to follow it up and to go round its source, and by this means they succeeded in keeping to the top of the main ridge, and in getting through to the plains beyond. An obelisk has been erected on Mount York, at the place where they realized that they had conquered the Blue Mountains, and began their descent on the far side of them.

As these men cut their way through the scrub they blazed certain gum trees to note their track, and one of these marked trees still stands on the roadside near Katoomba, the most popular of the mountain resorts. It is known as the Explorers' Tree, and there is not much of it left, but it is railed off and concreted up to make it last as long as possible.

In 1804 the Governor started convict labour on a road over the Blue Mountains, which is still the main high road, with the railway practically alongside it. In the bush near the Explorers' Tree are the graves of thirteen of these convicts, who died of some quick-killing epidemic. The guide books do not mention them, and one hears of them only by chance, but there they are in a small cluster, plainly to be seen by anybody seeking for them. Kindly hands have heaped stones, and small branches, and bush flowers on the graves, and have placed on each a rude cross formed of saplings. These crosses fall down at times, but some visitor replaces or renews them, for these nameless men were one's own countrymen—perhaps from one's own county—and one trusts that their crimes were not black ones.

Before we reach the mountains our train goes through historic Parramatta, and crosses the Emu Plains. It passes poultry farms, fields, and sheep runs, and then begins to climb, almost in the track of the dauntless three who found the way up 120 years ago. We pass all the pleasant mountain townships, and after a three hours' run arrive at Mount Victoria, where we leave the train.

We lunch at a hotel here, and at 2 p.m. start off for Jenolan in one of the large motor cars that carries the party. We descend the Victoria Pass and are glad when we are safely down, for there is a big drop on one side of the road. The Mt. York obelisk, and the English weeping willows by the Cox River interest us, and then for miles we traverse country that is being

cleared of trees. This process takes time, for the trunks are first ring-barked—a circle of bark cut off by an axe—which kills them by the loss of sap, and the dead trees are then burnt and cut down. These dead trees are of a greyish-white colour all over, trunk and branches, and as they stand there in their hundreds, gaunt and leafless, the country-side looks like a huge tree cemetery.

Here and there we pass a small shanty, and occasionally a collection of a few houses, but the whole area gives a sense of a lack of human life, and of wonder as to how the land yields anybody a living. Presently, however, a small war memorial by the roadside reminds us that the men are somewhere about. Soon we reach the highest point, 4,600 feet above sea level, and for the last three or four miles we pray for the staunchness of the driver and of the car, for if either fail we should be over the side of the road, rolling down for hundreds of feet. We descend 1,700 feet in three miles, the road being cut in the mountain side, and as we go round the sharp bends, tooting hard, we hope that there is nothing round the corner. Finally we run through a great arch in a mountain ridge, which is really a vast cavern broken through at both ends, and just beyond it we arrive at the Government Caves House Hotel—having done the 36 miles from Mt. Victoria in two hours.

The scenery at Jenolan is wild. All around are high mountains covered with trees and shrub, while the hotel and its annexes are the only habitations visible. They lie at the bottom of a funnel rather than of a basin, for the ground on every side rises so steeply and so high, that in the mild winter of this climate the hotel gets only one hour of sunshine daily. If it were not for the broken through cave by which one enters the funnel, the hotel would be completely shut in, and it is in the limestone formation of this cut-through mountain ridge that most of the famous caves lie practically in three storeys, one above the other. The waters have tunnelled their way through the obstruction to their outlet, and have gone right into the mountain and channelled passages downwards through the limestone, which forms the caverns we visit.

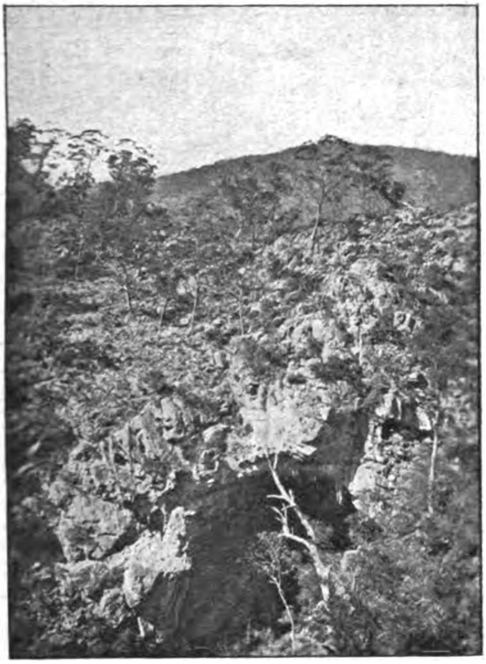
There are many caves here and in the vicinity, but practically only nine are ordinarily shown. A caretaker and a staff of some ten guides live on the spot, and conduct tourists through the caves twice daily.

The story of the discovery of these caverns by white men is not uninteresting. A convict named McEwen escaped from captivity and penetrated to the wild and unknown country around Jenolan, where he found two small caves which he used as hiding places. He must have seen the archway and two other great caverns, for they are obvious, but the rest of them have been found from time to time by exploration.

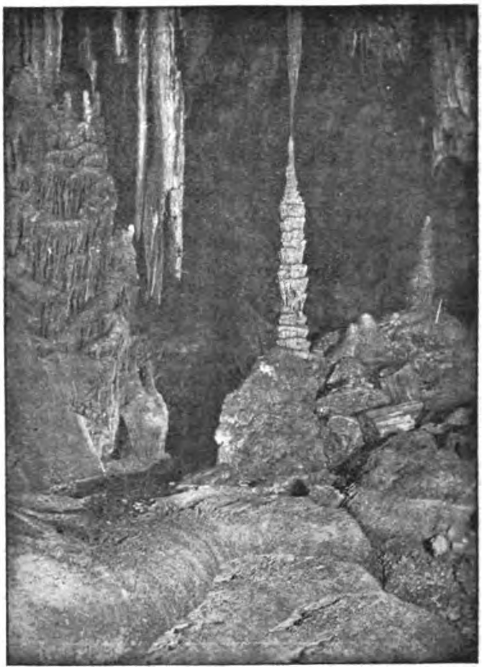
McEwen became a bit of a bushranger, and apparently lived for some time by robbing the nearest settler, named Whalan, of sheep and other food, but in either 1838 or 1841 he went too far by stealing a horse. Whalan then became annoyed, and traced the animal to McEwen's haunt.

Apparently the convict had been left unmolested owing to uncertainty as to whether he had companions or not, but Whalan now obtained the aid of two mounted police troopers, and the three men made their way into this unexplored region and saw the three great caves already referred to. They captured McEwen after a long hunt, for his chief haunt had a back door that his pursuers did not know of.

The fame of the caves gradually spread, and adventurous spirits occasionally visited them, but in 1866 the Government took possession of them, and stopped the genial custom of carrying away stalactites and other formations which was indulged in by the early visitors. It is said that most of these heavy souvenirs were dumped into the bush on the travellers' homeward journey.



Entrance to the Devil's Coach House.



The Spectre Column (Orient Cave).

The Grand Archway—the tunnel through which the road goes just before it reaches the hotel—is a great cavern 450 feet long, 35 to 180 feet wide, and 40 to 70 feet high. It forms a fitting prelude to the hidden caves, which are entered from its sides, and although its roof is so high yet a tortuous water channel is clearly marked upon it. Just outside this arch is another great daylight cavern—the Devil's Coachhouse—400 feet long and up to 160 feet high. The rocks and boulders of all sizes that lie in these two cavities have been so clambered over by wallabies—a species of small kangaroo—for unknown centuries, that their edges are polished to an

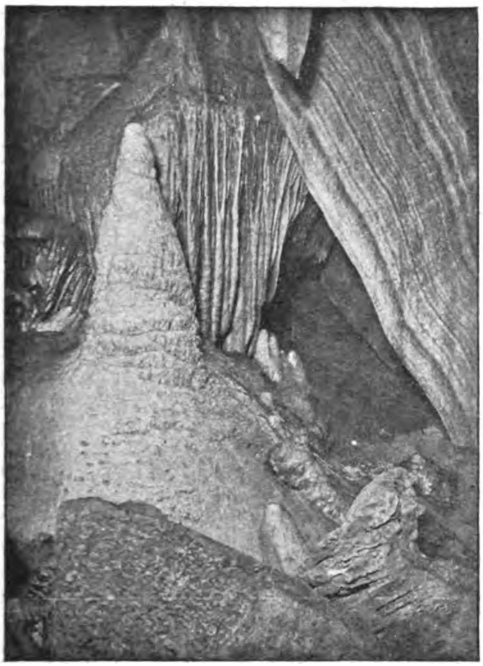
astonishing smoothness. Close at hand is the entrance to the Nettle and Arch cave, the third of the caverns that Whalan and the troopers saw in their chase of McEwen.

Formerly a visit to the hidden caves was no easy affair, but now narrow passages have been enlarged, steps cut, ladders and handrails provided, and electric light installed, so that an inspection is a comparatively comfortable matter. As the steps vary from a minimum of 700 to 1,472, and as some of the ladders are steep and slippery, liquid food is usually indicated at the end of the two hours which is the average time occupied in a tour of one cave.

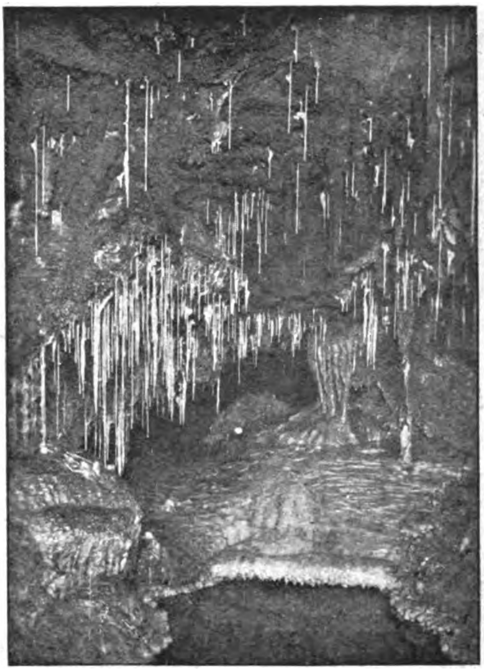
The electric lighting is not constant, but is turned on by the guide section by section, and the bulbs are arranged to show up special features of the formations of each cave, and in most places the effect is wonderfully beautiful. One looks upon a cave as a dark and dismal place, and at Jenolan one certainly goes through narrow passages and great chambers which satisfy all one's requirements and expectations, but the marvellous beauty of a limestone cave comes as a revelation. The stream has cut out the tortuous tunnels and the great caverns, but then Nature has set to work to decorate them by means of the slow drip of water which holds in solution lime and coloured minerals, and the result is a veritable fairy land. The beauty of the caves lies in the many forms which the deposit from the drip takes, and in their splendid colouring. The work has gone on for countless centuries, and has produced formations of many shapes and of many hues—snow white, smoky white, cream, pink, salmon, green, and brown. The prevailing tints are white and various shades of brown.

There are stalactites and stalagmites by the thousand, many of which have joined together to form pillars. The stalactites vary from three or four inches in length, with the thickness of a slate pencil to massive pendants many feet long and several inches in diameter ; the stalagmites also are of all sizes, culminating in one massive column which is forty feet high. Some of the columns and pillars are quite smooth and straight, while others are terraced or beautifully fluted. Many stalactites hang in numbers side by side, shaped like great tongues, forming immense canopies in white or brown. There are wonderful things called "shawls," which occur where the roof slopes. In these cases, instead of forming a pointed stalactite, the drip runs down the incline and makes a thin, wide structure which is just like a shawl or blanket hanging down. Most of them have narrow bands of a brown colour running with the utmost regularity from side to side of the shawl, exactly like the blue or red lines that one sees at the top end of a blanket. There are many of these "shawls" in the caves, of all sizes, but the champion one, in the River Cave, is 20 feet long and 4 feet wide. It is only about half an inch thick, and when the light is switched on to the bulbs concealed behind it and the whole structure glows, it is a superb sight.

There are strange objects called "mysteries," which it is said no man can explain. They are lime formations which defy the laws of gravity and they occur in the roof or sides of a chamber or passage singly or in clusters, forming delicate filagree work. Many of them are no thicker than a hairpin, and bend back on themselves just like one of those necessary articles. Most of them are only a few inches long and are very delicate and fragile, while others are larger, but all twist and bend in every direction, upwards and sideways. The puzzle is to account for the growth upwards of an object which is formed by deposit from drops of water.



The Great Shawl (River Cave).



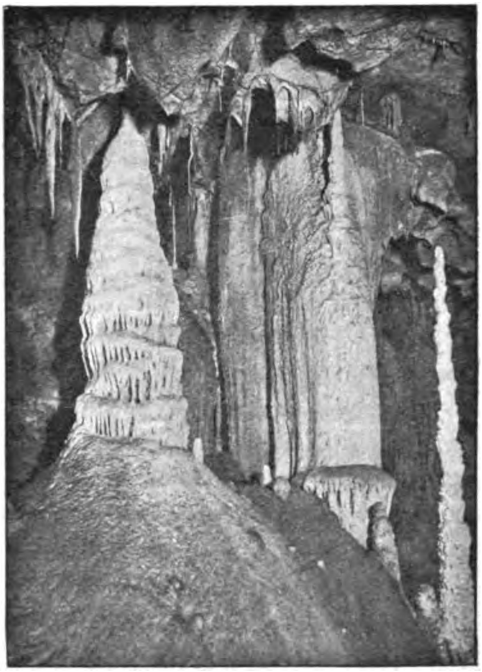
The Bath of Venus (Skeleton Cave).

There must be some action allied to the way in which fluid can run up a capillary tube. These mysteries are the most delicate formations in the caves, and they very closely resemble the work of an artist in spun glass, while it gives one quite a jolt to see such fragile and beautiful things in the depths of the earth.

All over the caves there are formations which at once suggest well-known objects, one of the best being the "weeping willows"—a structure which is not only perfect in shape but is green in colour. Here and there are small cavities, known as jewel caskets, which contain masses of crystals which look just like diamonds as they scintillate in the light. In certain places the guide turns a large hand electric lamp on to the walls, where

crystals glisten and twinkle like stars in the heavens. There are fairy-like grottoes, and one recess in particular—the Mafeking Cave—is indescribable in its beauty. It is one mass of countless delicate stalactites and pillars, sparkling cascade formations in white and various tints of brown, tongues, canopies, mysteries, silk-like shawls, and jewels—all crowded into a small space and glistening in the light.

Every now and again one comes to the underground river, the Styx, which until lately had to be crossed in a punt, and one is led to the spot, deep down, where it is usual to throw coins into the water, which are



In Mons Meg Chamber (Lucas Cave).

retrieved annually and given to charities. The water is quite clear and its motion almost imperceptible, so the coins are clearly seen lying a foot or two below. The use of paper money has caused a big loss here, as many sovereigns used to be fished out in the days when they circulated.

In one cave there is an extraordinary formation on the floor, where a pool once existed, which resembles a group of Lilliputian cities, with walls and fortifications five or six inches in height. These so closely copy the thick ramparts of ancient days, and are so realistic in their setting, that at first one can hardly believe that they have not been faked up for the astonishment of visitors, especially as the open spaces seem to be full of people.

The Skeleton Cave is so named because it holds a human skeleton embedded in the floor. These bones are supposed to have belonged to some luckless aboriginal who probably entered by some small opening in the hill side, and then in his wanderings in the darkness fell down unseen shafts and chasms, for he lies deep in the bowels of the earth. The guide suggested that this may have happened 6,000 years ago.

In the Temple of Baal our party stood in an awed silence, with a feeling of being in church. Above was a dome ninety feet high, lighted up; on the floor beneath was a glistening pure white stalagmitic mass measuring thirty feet across. This was the white altar. Close by was a similar red altar, while around hung great shawls like angel's wings, and beautiful clusters of delicate mysteries. There were grand masses of large brown lime "tongues," and stalagmites which resembled images. The whole chamber was most majestic and impressive, and at no other time did we notice a party of tourists so reduced to silence by the sublimity of their surroundings.

One could write volumes about the Jenolan Caves, and to have seen them is an education. For countless centuries, hidden in the depths of the earth, Nature has been preparing these works of grandeur, massiveness, and majesty, contrasted with delicacy, charm, and fragility. Our generation gazes on them enthralled, but so slow is their growth, that although the work is still going on, yet many centuries hence those who come after us will see much the same effects as we see now.

We inspected seven of the caves, and returned to Sydney on the Friday by the same route as we had gone. As we left the grand mountains and the marvellous caves we felt that we also had seen the works of the Lord and His wonders in the deep—of the earth.

Current Literature.

The following abstract of an address delivered by Professor Calmette before the Medico-Chirurgical Society of Edinburgh on June 7, 1922, is circulated on the recommendation of the Senior Medical Officer Med. III, Ministry of Health, in whose branch it was prepared.

The Protection of Mankind against Tuberculosis.—Villemin, finding it difficult to transmit tuberculosis to the dog, the cat, and the sheep, was the first to raise the question whether animals existed which were non-sensitive to this disease.

Later, we learned that almost all the mammalia could be artificially infected, but that only a small number of species contracted tuberculosis spontaneously, and that some others were so highly resistant as to be immune even to artificial inoculation.

For example, there exist certain rodents, the *gerbilles* (*Meriones shavii*) and the *spermophiles* (*Spermophilus citellus* or *fulvus*) into which tubercle bacilli can be injected subcutaneously without any effect, save a local lesion which has no tendency to become generalized and which causes no serious functional disturbance.

These non-tuberculizable animals are thus *naturally resistant.* Tubercle bacilli remain within their fluids or tissues as inoffensive foreign bodies. For months, even for years, they may be traced round about the point of inoculation, where they preserve their vitality and virulence and are perfectly capable of tuberculizing other susceptible animals, such as the guinea-pig.

Our aim in the production of *artificial immunization* must be to establish a tolerance of this kind. The chitinous membrane containing waxy and fatty substances which envelopes the toxic and toxigenous protoplasm of these bacilli constitutes such an obstacle to the digestive action of the leucocytes, that we cannot conceive antituberculous immunity as resulting from a process analogous to that which occurs in the case of immunity to the acute infectious diseases—a process characterized by the formation and rapid massive circulation of *antitoxins* and of *bacteriolysins* in the fluids of the body.

The problem may be put therefore as follows: How to render the leucocytes and the endothelial cells of the vessels—which enclose the tubercle bacilli but are unable to digest them—how to make these cells non-sensitive to the poisons which these bacilli contain and secrete (endo- and exotoxins), so that the organism may tolerate them.

Robert Koch observed that tubercle bacilli, whether living or killed by heat, act very differently according *as they are introduced subcutaneously into a tuberculous guinea-pig or into a healthy guinea-pig.*

While, in the case of a *healthy* guinea-pig, they give rise only after several days to the formation of a nodule which discharges externally, causing an ulcer which may continue till the death of the animal and which leads to intense swelling of the neighbouring lymphatic glands, a similar inoculation in the case of the *tuberculous* guinea-pig produces a small abscess which quickly bursts and discharges and cicatrizes without swelling of the neighbouring glands.

This phenomenon of Koch the importance of which from the point of view of immunity to tuberculosis had apparently escaped Koch's attention, affords evidence of the *intolerance of the tuberculized individual to fresh infection.*

Experiments show that this intolerance becomes more and more marked, and reveals itself by an effort to expel the bacilli which is more intense and more rapid with *each fresh reinfection.*

This is then exactly the reverse of what ought to be realized in a true *vaccination against tuberculosis.*

The local tuberculin reaction now used for the earliest possible diagnosis

of bacillary infection, indicates that bacillary infection is almost inevitable in the course of childhood, especially in our crowded city areas.

When the age of 15 is reached the proportion of infected children is ninety per cent. It is thus very exceptional for the individual to reach adult age and escape every chance of infection.

In the Paris hospitals, of 100 children dying in the course of the first year of life, twenty-eight deaths are due to tuberculosis, and of 100 deaths of children during the second year, twenty-six, while for children whose ages range from 3 to 15 years the collective percentage of deaths from tuberculosis does not exceed seven.

It is thus *in earliest infancy* that household contagion, which is almost inevitable for babies born of phthisical mothers, is most serious and most generally fatal, because it is *massive* and *repeated day by day*. After the third year such infection is less formidable. Then it is occasioned by accidental exposure and intermittent contact, which produce more often glandular lesions of benign character very frequently curable, and induce that characteristic state of *intolerance of fresh infection* shown by the tuberculous patient.

It seems then that for man, as for animals which develop tuberculosis spontaneously, such as the bovines, one early and slight inoculation is desirable, provided that it is not followed by further *repeated, massive* infections. Such slight inoculation confers on the organism a resistance which, while not a true immunity, protects it in case of subsequent reinfections of grave character from developing the disease in rapidly fatal form. It may be affirmed that *every subject infected in childhood by a very feeble dose of bacilli is rendered less likely to contract acute miliary tuberculosis.* Should the individual be exposed later to repeated or massive contagion, he will show his intolerance to reinfection by developing chronic tuberculosis (phthisis) or cold abscesses or other local tuberculous lesions which suppurate readily.

Likewise, *slight infections not repeated* tend to be benign in the case of children, while, contrariwise, they are grave in the adult who has remained virgin soil in respect of bacillary implantation. This is why country people who, after adolescence, have migrated to the city, develop so often a serious type of tuberculosis, it may be, rapidly fatal. It explains similarly why negro races coming from the centre of Africa, where tuberculous infection has not yet penetrated, are so sensitive when they are transferred to a European country, where it is difficult for them to escape opportunities for infection.

Attempts were made to use tuberculins and bacillary extracts as a vaccine. But these substances which are hardly toxic for healthy subjects are incapable of conferring appreciable resistance on animals which are afterwards inoculated with bacilli.

Next, one turned—with more encouraging results—to living bacilli more or less modified in their virulence, or passed through different animal species.

The attempts of Behring to vaccinate young calves by intravencus inoculation with bacilli of human type occupied for long the attention of biologists. This "jennerization" of cattle, as it was called, became in 1902 the subject of numerous observations and important applications among cattle. It was possible to conclude that the bovovaccin of Behring confers on young calves an appreciable resistance to different modes of natural and artificial infection, but that this resistance—of brief duration, not exceeding twelve to fourteen months—does not allow the organism to absorb test bacilli of virulent character nor even those introduced as vaccine. These bacilli one and all are retained for months in the lymphatic glands, and continue there ready to show more or less abruptly their presence by anatomical disturbance as soon as the resistance artificially conferred by the vaccination begins to give way.

It is now known that vaccinated animals eliminate in their excreta, and milch cows especially by way of the mammary gland, tubercle bacilli which have the characters of the human type. Such elimination evidently entails grave risks which have led to the complete abandonment of the method.

Some degree of hope was also placed on the sensitization of living bacilli by means of certain serums rich in antibodies, and obtained from tuberculous animals injected either with dead bacilli or with bacillary extracts. But it was found that the microbes, thus sensitized, in place of vaccinating, produced a more rapid infection than the same bacilli, living but not impregnated with antibodies.

Another attempt, of rather risky character, was made by Gerald Webb and W. Williams, who proposed to inject very small doses of virulent bacilli—*single* bacilli—in such a way as to effect a latent infection analogous to that which is produced spontaneously by slight contagion, and *thus* obtain protection against reinfection. But this method, which was never practised save in the laboratory, is evidently too dangerous for general use.

Calmette and Guerin observing the modifications undergone by the tubercle bacillus (*in culture*) in its passage through the digestive tract, and thereafter by the implantation in long successive series on an artificial medium containing pure ox bile, were able to obtain a growth of bacilli completely free of virulence for the guinea-pig and rabbit, and perfectly tolerated in large intravenous doses—up to 100 milligrams—by the ox and capable of producing tuberculous lesions in the organism.

For several years they had employed this *non-tuberculigenous* bacillus for the vaccination of calves, and had obtained some interesting results which their recent work has entirely confirmed and extended. It has now been demonstrated that the bile-treated bacillus, injected intravenously, is inoffensive to all mammalia and never produces tubercle, and that it confers on animals manifest tolerance in respect of infections or experimental inoculations.

Unfortunately this tolerance is not of very long duration. In the ox it does not exceed eighteen months. In the rabbit and guinea-pig it seems

to last five or six months. It disappears when the vaccinating bacilli have been completely eliminated from the organism, and it continues so long as the bacilli continue their life in the lymphatic cells. There is some hope that the tolerance would be maintained or prolonged by revaccination made at suitable intervals in such a fashion that the production of Koch's phenomenon would be avoided, but this possibility has not yet been demonstrated.

It is further very difficult to prosecute these attempts at antituberculous vaccination in laboratories and in countries where bacillary infection is so widespread that a given animal cannot certainly be protected from accidental contagion. It would be necessary to make the attempt in an environment above suspicion, in a country where there are no men, no cattle, nor other tuberculous animals.

That is why Calmette has proposed the creation of a centre of research in a position as isolated as possible, preferably on the West Coast of Africa in the great belts of forests inhabited by large anthropoid apes, especially the chimpanzee.

In such a laboratory one could, for as long as might be serviceable, keep the vaccinated animals in a state of semi-liberty, securing for them in the heart of their native country nourishment and conditions of climate and life generally in conformity with their needs. After a more or less prolonged interval we should be able to test on the spot their resistance to artificial infection, or they might be transferred to Europe where they would be exposed to natural contagion which so cruelly affects their congeners in menageries.

Without waiting until such a project can be realized, it is our duty to pursue investigations which tend to produce in young animals susceptible to tuberculous infection, and in young children, that particular state of intolerance to reinfections which may result *from the early implantation in the organism of a small number of slightly virulent bacilli, or by bacilli which do not readily produce tuberculous lesions.* It seems that at present this is the way which ought to lead to the most satisfactory results.

Antiseptic agents introduced either into the blood circulation by subcutaneous or intravenous injection, or by inhalation in combination with air, can destroy the bacilli *within the tuberculous lesion.* The substances are destroyed or decomposed or become fixed in the tissues long before the lesions can be reached.

The tuberculous cell is no longer a normal cell but a new complex produced by the symbiosis of tubercle bacilli, and of the elements which constitute the giant cell (just as the lichen is the product of the symbiosis of an alga and a mushroom), and can exist independently of the organism which serves as host. The tuberculous cell is no longer linked to its host by any capillary vessel. It becomes more and more isolated in proportion as it tends towards caseation or towards calcification. It is nourished only by way of osmosis, and it is also by way of osmosis that the normal cellular

elements which surround it become impregnated with toxic products which it diffuses externally.

It is only possible to conceive of effective action on tuberculous cell formation by a chemical agent, provided that agent possesses in the first place sufficient stability to ensure its carriage without decomposition or modification to the cellular protoplasm which surrounds the tubercles, and provided thereafter it can penetrate by osmosis into the tuberculous cell itself, so as to act on the protoplasm of that cell or on that of the bacilli therein contained.

It is still possible that some chemical substance might exercise an indirect influence on the tubercles by *favouring the transformation into fibrous tissue of the unaffected cells surrounding the tuberculous focus.* It is no doubt in this way that calcium salts act, possibly also various salts of copper and certain iodine compounds. When the fibrous tissue becomes sufficiently dense to interrupt or suppress the process of osmosis, the complete isolation of the tubercle leads to its death and the degeneration of its protoplasmic and bacillary content. Such a curative process is happily of frequent occurrence. It is the rule in cases of discrete tuberculous infection, and is seen sufficiently often even in the case of most susceptible animals such as the guinea-pig, in the event of their inoculation with a few *single* bacilli of slight virulence.

In spite of the efforts which have been made to discover among chemical agents a substance capable of preventing or arresting the evolution of experimental tuberculosis in the guinea-pig or rabbit, the results so far recorded have not been very convincing.

This, however, is no reason for discouragement.

The most important conception is that the best safeguard whereby to protect against grave infections is the presence within our lymphatic system of bacillary elements of such slight virulence as will not cause tuberculous lesions, and sufficiently distributed that some of them will remain sufficiently long in our tissues and there establish that particular state of immunity which in tuberculosis implies *intolerance to reinfections.*

The essential aim we must ever have in view is not, as some have supposed, the exclusion of possibility of bacillary contagion, but rather the realization of contagion, in all human beings, *as soon as possible after birth*, in a form which is inoffensive and protective for a sufficiently long time against serious infection. The establishment of such resistance on the part of infants ought then to become the immediate object of our constant endeavour. *The child must be immunized from his earliest age*, firstly, because in infancy it is most exposed, and further, because it is relatively easy to shield it from repeated and massive contagion which irremediably imperils its life.

The practical conclusion which emerges from our present-day knowledge is that our *efforts should principally be directed towards the protection of childhood.*

That protection is realized most effectively in the first place by removing the infants of phthisical mothers separately to healthy households in the country, thus insuring their protection from infective contact during the first two years of life; next by the removal of families or larger groups of children from 3 to 13 or 14 years to sanitary conditions above suspicion; and finally by the constant surveillance of schools, of apprentice workshops, and food supplies, such as milk, which may contain or carry tubercle bacilli.

One may hope that later, when knowledge has advanced still further, it will be possible to confer on babies, from the moment of their appearance in the world, through the ingestion of, or inoculation with, a certain number of living but *non-tuberculigenous* bacilli, the capacity to resist accidental virulent infection.

The whole world awaits anxiously such a realization.

Notes on the Outbreak of Smallpox in Heanor Urban District. Extract from Memorandum No. 57 issued by the Ministry of Health. In this brief report Dr. Jubb gives certain particulars of the vaccinal condition of persons attacked by smallpox, and the population, vaccinated and unvaccinated, in the invaded houses in the Heanor Urban District, Derbyshire. The numbers dealt with are small, but the facts reported can be taken as a sample of what is occurring in other districts in the North Midlands.

Dr. Jubb ascertained that of the 55 cases of smallpox, 11 had been vaccinated in infancy, but not since, and 44 had never been vaccinated previous to the onset of the illness: of the patients therefore: 20 per cent had been vaccinated, 80 per cent had not been vaccinated.

Dr. Jubb then investigated the condition as regards vaccination of the population of the houses invaded by smallpox in Heanor.

There was a population of 308 in those houses; the following table shows the number of vaccinated and unvaccinated and the number ill among these:

Population in houses invaded by smallpox	Number vaccinated	Number of vaccinated ill with smallpox	Number unvaccinated	Number of unvaccinated ill with smallpox
308	155	11	153	44

In the invaded houses, of vaccinated inmates 7 per cent suffered from smallpox and of unvaccinated inmates 28·3 per cent suffered from smallpox. The *age incidence* is shown as follows, with vaccinal conditions:

Vaccinal condition	Under 5	5—20	20—30	30—40	40—50	50—60	60—70	Over 70	Total
Vaccinated	—	—	—	—	3	4	3	1	11
Unvaccinated	3	28	10	2	—	1	—	—	44

Of the vaccinated persons in the above table all were over 40 years of age and had not been vaccinated since infancy.

Therefore in a population composed of nearly equal numbers of vacci-

nated and unvaccinated persons, the number of unvaccinated persons affected with smallpox was four times as large as the number of vaccinated affected and furthermore not one of the vaccinated so affected had been vaccinated within forty years.

The type of the epidemic was mild: there were no confluent cases and no deaths.

The small incidence of the disease on children under 5 years of age was noticeable here as in epidemics of this type elsewhere, and the suggestion has been made that this may be due to the recent vaccination of the fathers when in the army. Dr. Jubb, however, thinks that if the children have inherited immunity it is more likely to be due to protection afforded to them by recent vaccination of their mothers.

Reviews.

MEMOIRS. WITH A FULL ACCOUNT OF THE GREAT MALARIA PROBLEM AND ITS SOLUTION. By Sir Ronald Ross. London: John Murray, 1923. Pp. vii + 547. Price 24s. net.

Few fields in literature present greater difficulties than the writing of an autobiography. The perfect autobiography is rare, because it necessitates that the man and his life's work be understanded by and appeal to the people and also that, in their representation to the public, the balance between the man and his subject be so poised that the latter rather than the former is always in the foreground. In the case before us, these conditions are not fulfilled. Malaria is not understanded by the people and does not appeal to the public and we think never will appeal. With us, however, it is otherwise because we understand what malaria is and how great is its toll among dwellers in the tropics and our colonial dependencies. From this point of view we welcome this book because it tells us the whole story of how a great mystery was explained and lays stress upon the lines along which improvement is to be secured.

In generations to come, three names will be associated with the subject of malaria. Those names are Laveran, Golgi and Ross. In the year 1878 Laveran, a French army surgeon, working at Bône in Algeria, with a microscope which to-day would disgrace a secondary school, discovered and described accurately the malarial parasite as it is found in human blood. His discovery and observations were epochal; he detected the parasite in the blood corpuscle, watched it multiply by a process of budding or sporulation, and observed that when the buds or spores were ripe the parent cell burst to release them into the blood-stream. More than this, he noticed that all the parasites were not of this simple kind; there were other kinds or forms which, in drawn blood, changed in a curious and, to

him, inexplicable manner. He lived long enough, for Laveran died in 1921, to know ultimately their meaning, for these bodies were the sexual forms of the *plasmodium* destined to live and multiply in the bodies of mosquitoes. Laveran's work was further developed by Golgi who described the asexual cycle of the malarial parasite in the blood of man and how one form of the parasite takes seventy-two hours to complete its budding, whereas another form accomplishes this process in forty-eight hours, these being respectively the so-called quartan and tertian types of malaria. We know now that at the time when the buds or spores are released into the blood the fever attack begins and does not end until each bud has found and entered a fresh blood corpuscle to begin again its own budding process. Laveran and Golgi thus established the facts in respect of man.

This much was known of malaria when Ross, who was then an officer in the I.M.S., returned from India in 1894, and made the acquaintance of the late Sir Patrick Manson. The memoirs now under review admit the fact that at this time Ross was no believer in the accuracy of Laveran's work, a circumstance which we can confirm, because we well remember reading the essay which Ross sent in for, and with which he obtained, the Parkes Memorial Prize of 1896, and, although supported by many photomicrographs, the author in that essay argued against both Laveran's *plasmodium* and the suggestion of Manson that mosquitoes might be the carriers of malaria, just as they carry filariæ. This was not an original suggestion on the part of Manson, as the view had already been expressed by others, but the volume before us contains many interesting letters which passed between Manson and Ross during the succeeding years, and from which it is clear that although the former held some very erroneous and highly imaginative views regarding the possible and actual life-history of the malarial parasite, the author owed much to the encouragement and support which he consistently received from Manson. Manson was obsessed by the view that mosquitoes liberated the germ from their bodies into water, and that it was by this medium that man acquired the infection. With these crude ideas, Ross returned to and worked in India. It took him some two years to make any advance, but that advance was made when he discovered that it was only in the *anopheline* group of mosquitoes that the human malaria parasite passed through important morphological and physiological changes. Because of other duties, Ross found himself remote from human malaria upon which to pursue his inquiries and work for some long while. He then adopted a suggestion of Manson and devoted himself to investigate avian malaria, already shown by Laveran to be due to a similar parasite in the blood. This departure was destined to be the turning point, for not only did he find and trace the same *zygotal* phase of the avian parasite in the stomach of mosquitoes, but made the even more brilliant and unexpected discovery that spores from the stomach phase found their way to the salivary glands, and when the insect pierced the skin of an uninfected bird with its proboscis, it injected some of the

malaria germs, and so infected the new host. This was in 1898, and within twelve months confirmation was forthcoming that a precisely similar sequence of events occurred in the case of human malaria, and Ross had linked up Laveran's and Golgi's discoveries as to the history of the malaria parasite in man with its history in the mosquito, and how the latter history was the essential complement of the former.

Such, in brief outline, is the story told in these memoirs, but to appreciate the magnitude of the work done, and the difficulties under which it was performed, the book should be read. We can assure the reader that it will not be time wasted, because the book conveys a lesson, and that lesson is, that in spite of difficulties and official apathy, a self-taught man may succeed where experts fail, and that a want of initial academic distinctions is no bar to an ultimate success in scientific research. The book is, moreover, interesting as disclosing the versatility and catholicity of interest of the author, for Ross is not only a self-taught microscopist and biologist, but he is a self-taught mathematician, musician, poet and dramatist. The latter part of the volume is devoted to the writer's work since he left the Service, and covers a wide field of activities against malaria. We refrain from expressing any opinion as to his success or failure in these regions of human endeavour, other than to say that such success as may have attended them is traceable to his own enthusiasms rather than to that of others, and that where there have been failures they are due to the well-known fact that the deafest people are those who will not hear, and the blindest are those who will not see. R. H. F.

A Green Old Age. By Professor A. Lacassagne. Translated from the second French edition by Herbert Wilson. London: John Bale, Sons and Danielsson, Ltd. Pp. 321, with 17 plates. Price 15s. net.

It happens that we have had access to a copy of the original second edition of this book and we say at once that Mr. Wilson is to be congratulated upon his excellent translation of a work which is both curious and interesting. The author, who for many years has been a leading authority in French medical jurisprudence, is a man of 80 years, and, therefore, competent to write upon the subject of senescence. It is no mere medical summary of old age, for although the author discusses the technical aspect of this period in man's life with wise advice as to its hygiene, he enlivens it all with delightful extracts from the opinions on the old as viewed by philosophers and artists and, moreover, illustrates his volume with seventeen quaint and suggestive illustrations. This mixture of scientific and other observations makes a helpful guide to the body and a pleasing solace to the mind of all those who look forward to the enjoyment of a green old age. Unlike many moralists and not a few physicians, the author holds out no panacea for either mind or body, because in respect of both there are few remedies, many drugs but no specifics. His theme is, that in order to love life we must have an accurate idea of the conditions

which keep it in being, and once that is understood there is no surer way of sustaining life than by the practice of temperance, goodness and charity. In other words, the whole book may be summed up in these terms, "In green and vigorous old age the threefold rule of life consists in intellectual and moral activity of the brain, in diet and in exercise." Few will be prepared to challenge the truth of this, since gluttony and idleness are the chief causes of failure to reach old age and to enjoy it. Gluttony is the vice of those minds who have nothing inside them, while moderation is like sobriety, since a man would often like to eat more but fears to make himself ill. Old age is the fruit of sobriety, and if it does not yield all its desire, that is no reason why it should be refused. An old man enjoys life fully so long as he is able to carry out all his duties; in this is old age more strong and more courageous than youth, and for those who doubt the joys and pleasures of a green old age there is no better companion for study than this book. Let him who ages, read.

R. H. F.

CHARLES WHITE OF MANCHESTER AND THE ARREST OF PUERPERAL FEVER. By J. George Adami, F.R.S. London: Hodder and Stoughton, Ltd. 1922. Pp. 142. Price 5s. net.

This was the subject of the Lloyd Roberts Commemorative Lecture at Manchester Royal Infirmary in 1921. The lecture was delivered by Professor Adami, Vice-Chancellor of the University of Liverpool, and has now been published by Hodder and Stoughton, together with White's writings upon puerperal fever originally published in 1773.

This little book is extremely interesting reading in the light of modern obstetrics. The first part consists of Adami's Lloyd Roberts lecture, in which he calls attention to White's pioneer work in the prophylaxis of puerperal fever by the use of disinfection by antiseptics, and better hygiene of the lying-in room. He lays great stress on fresh air and ventilation, segregation, and clean bed linen. If only he had advocated the use of antiseptics for the hands also, he would have reached a standard not far short of modern ideas.

Charles White founded the original Manchester Infirmary in 1752. He was a friend of William Hunter.

At a time when the mortality from puerperal fever in many institutions in Europe was as high as twenty per cent, White claimed that he had never lost a case from puerperal fever, excluding cases where obstetrical complications had occurred.

Professor Adami is of opinion that Semmelweis of Vienna owed most of his ideas on prevention of puerperal fever to the English teaching.

It is interesting to note that White was advocating antiseptic douches and disinfection with chlorine in obstetrics thirty-five years before "Lister" introduced his antiseptic methods into surgery. He strongly recommended

drainage of the uterus by early sitting up, and getting out of bed on the second day.

He laid particular stress on the value of ventilation, which must have been very necessary judging from the following description of a lying-in room : "When the woman is in labour, she is often attended by a number of her friends in a small room with a large fire, which, together with her own pains, throw her into profuse sweats ; by the heat of the chamber and the breath of so many people, the whole air is rendered foul and unfit for respiration," and "If the woman's pains are not strong enough, her friends are usually pouring into her large quantities of strong liquors, and if her pains are very strong, the same kind of remedy is made use of to support her. As soon as she is delivered, if she is a person in affluent circumstances, she is covered up close in bed with additional clothes, the curtains are drawn round the bed and pinned together, every crevice in the windows and door is stopped close, not excepting even the keyhole, the windows are guarded not only with shutters and curtains, but even with blankets, the more effectually to exclude the fresh air, and the good woman is not suffered to put her arm, or even her nose out of bed, for fear of catching cold."

His revolutionary ideas in the matter of fresh air, baths, and cleanliness must have met with reproof and ridicule from the less enlightened of his day.

He recommended cold and tepid baths to prevent miscarriages, some ladies of his acquaintance had even taken to having two or three baths a week whilst pregnant, and writes, "I am not now amusing the public with idle theories and speculative reasonings ; I am treating of an affair of consequence not only to the female sex, but to mankind in general."

He gives an interesting definition of the difference between "perspiration and sweating." "Perspiration is that insensible discharge of vapour from the whole surface of the body and the lungs which is constantly going on in a healthy state, &c." "Sweat on the contrary is an evacuation which never appears without some uncommon effort or some disease in the system that it weakens and relaxes, and so far from coinciding with perspiration, obstructs and checks it."

When one reads the Registrar-General's statistics for 1919, and learns that for that year no less than 3,204 deaths were returned as due to "pregnancy and childbirth," one wishes that there were more men like White at the present time, who, nothing daunted at being called enthusiasts and extremists, would press home to the Nation and Government the vital necessity for maternity homes with efficient and well supported ante-natal departments for all women all over the country. Surely it is saner policy to ensure healthy mothers and babies than to spend money on patching up the chronic cases that flood the County General Hospitals.

Professor Adami is to be congratulated on his lecture, and book, and especially on the choice of a subject of such great importance.

E. L. M.

Correspondence.

THREE CASES OF TROPICAL SORE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I was interested in reading Major Andrews' account in this month's Journal of his three cases of Tropical Sore treated with antimony tartrate ointment.

For some considerable time now I have practised this method when dealing with small single sores, and in No. 33 General Hospital, Basra, it was the routine treatment.

As brought out by Major Andrews, the essence of the treatment is the production of a very considerable local reaction, painful though it may be and of which the patient should be forewarned. A sufficient reaction is usually produced by a twenty-four hours' application. A certain amount of sloughing of the parasitized cells ensues and the subsequent cleansing and healing of the ulcer are assisted by application of simple fomentations.

I have seen large "butterfly" sores on the nose and cheeks treated successfully in this way, leaving very little scar, but for such extensive involvement of the face intravenous injection of antimony tartrate is to be preferred. For multiple sores, likewise, the intravenous method is preferable.

I am, etc.,

R.A.M. College,
May, 22, 1923.

J. C. KENNEDY, *Colonel,*
Consulting Physician to the British Army.

ACARI IN SPECIMENS OF URINE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—In an article published in the Journal for November, 1922, I described cases in which acari had been found by myself and others in specimens of urine from cases of nocturnal enuresis, albuminuria, etc., and it was stated that the evidence required careful sifting and examination.

With this in view, hospitals were asked to send in specimens from all such cases, with special precautions as to cleaning and sterilizing the bottles used. Particulars of these were kept, and in the course of a few months eighteen positive cases were recorded, the majority of the acari found being *Tarsonemus*, whereas twenty-seven cases were negative on repeated examination. From time to time samples from normal individuals were taken in the laboratory as controls, and these were in all cases negative.

As opportunity offered, positive cases were brought to the laboratory and specimens taken for examination, but in none of these could any trace of acari be found. Eventually nine positive cases were investigated in this way. It now became evident that acari were to be found only in specimens sent to the laboratory in bottles, but specimens of urine

taken in specially prepared glass vessels in the laboratory were always negative. The special preparation consisted of scouring with a brush, flushing under the tap, sterilizing in hot air at 180° C. for twenty minutes, and storing in weak formalin.

Suspicion being thus thrown on the bottles as the probable source of the acari, a number of these were obtained from hospitals and examined, new unused bottles being selected for the purpose. These were found to contain particles of sawdust or of wood-wool which had been used as packing. Distilled water was placed in the bottles and the centrifuged deposit examined. No traces of acari could be found in any of these, and the explanation was still obscure.

Eventually some new bottles, obtained from a hospital which had been sending in positive specimens, were found to contain debris consisting of particles of hay or straw. The centrifuged deposit from water placed in these bottles contained numerous acari, in some *Tarsonemus* only, in others *Glycyphagus* and *Tyroglyphus* as well as *Tarsonemus*, whereas one contained a few specimens of the predatory *Cheyletus* in addition to the other varieties. One bottle contained *Glycyphagus* in all stages, some alive, some dead, with several empty exoskeletons, and much mitey debris. Samples of sawdust and wood-wool which had come from the Army Medical Store, Woolwich, were found to be free from acari, while straw, which had been used by a contractor for packing, contained large numbers of them.

The chitinous exoskeleton of the acari is extremely resistant to the action of chemical agents. Chitin is described as an amorphous white substance containing nitrogen, but free from sulphur. It may be prepared from the cleaned exoskeleton of a lobster or from the pen of a squid. Its resistance to acids and alkalies is very great. It is unaffected by digestive ferments, by water—hot or cold, by alcohol or ether. It may be dissolved by strong mineral acids—HCl or H_2SO_4. Chemically it is regarded as a derivative of carbohydrates and may be split up into sugar and glycosamin. Its formula is variously given as $C_{15}H_{26}N_2O_{10}$ and $C_{60}H_{100}N_8O_{38}+nH_2O$.

These properties of chitin explain the presence of acari or their exoskeletons in certain bottles and glassware that have been treated with dilute acids, alcohol or boiling, and experiments have demonstrated the occasional failure of such methods to get rid of these chitinous exoskeletons, e.g., in a finely-pointed conical urine glass that has been cleaned and sterilized in the usual way, they may still be present in the narrow pointed end, to be dislodged at last by the suction of the pipette.

It would appear that the occasional presence of acari in specimens of urine is due to the hay or straw sometimes used in packing glassware and to the resistance of chitin to the action of heat and chemicals.

Chester,
June 4, 1923.

I am, etc.,
J. Mackenzie,
Lieutenant-Colonel, R.A.M.C.

THE EFFECTS OF HEAT IN THE TROPICS.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—In the Journal for May of this year there is the first instalment of a scientific research into the physiological and economic side of Digging. Not long before the war there was an equally valuable inquiry into the physiology of Marching. In my humble opinion these inquiries into the daily round and common task of the soldier constitute a royal road to the success of military medicine, viz.: the prevention of inefficiency. It is only by scientific knowledge of the soldier's life—food, work, etc.—that we can lay our finger on the weak spots in that life and point out the appropriate alterations and improvements.

The scientific inquiries referred to have reminded me of one subject that has, alas, been neglected by the military-medical service, namely the inefficiency caused by "the Effects of Heat." Some twelve years ago I referred to this in the Journal in a short article entitled "Heatstroke: a Heresy," but the article led to no discussion or expression of opinion. The heat in tropical climates affects the efficiency of troops in several ways—health, training, movements, etc.—and leads to a considerable expenditure of money, the ruling factor in present-day soldiering. One need only mention the establishment of the multitude of heat-stroke stations in the Tropics, the continued issue of spine pads under divergent conditions and apparently without scientific reasons, and the issue of solah topis and regulation helmets side by side, as illustration of the work, money and anxiety expended over this question. A scientific inquiry into the Effects of Heat in the Tropics would probably amply repay the cost and labour involved. It is sincerely to be hoped that this inquiry will not long be delayed.

I am, etc.,
W. H. OGILVIE, *Colonel, I.M.S.*

Murree, Punjab,
June 7, 1923.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subcriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to The Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W. 1.

All Applications for Advertisements to be made to—

G. STREET & CO., Ltd., 8, Serle Street, London, W.C. 2.

VOLUME XLI. SEPTEMBER, 1923. No. 3.

Journal of the Royal Army Medical Corps.

Original Communications.

ARMY HYGIENE ADVISORY COMMITTEE REPORT No. 3.

ON THE MAXIMUM LOAD TO BE CARRIED BY THE SOLDIER.

BY PROFESSOR E. P. CATHCART, F.R.S.
CAPTAIN D. T. RICHARDSON, M.C.
Royal Army Medical Corps.
AND
CAPTAIN W. CAMPBELL
Royal Army Medical Corps.

From the Physiology Institute, University of Glasgow.

(*Continued from p.* 98.)

(5) *Marching to Exhaustion.*

We now come to the discussion of the last series of special marching experiments. In the tests about to be described an attempt was made to march the subject to complete exhaustion using 35 per cent, 40 per cent and 45 per cent of the body weight loads, with and without rests. The results of the experiments will be found in Tables XVII, XVIII and XIX. The march was carried out in a long, well-lit, granolithic-floored corridor with very ample room at both ends for turning. The pace at which the march was made started at approximately 5,800 metres per hour (see Table XIX). The average duration of the march was two and a half hours and the distances in miles covered in the march were as follows :—

	Richardson			Campbell		
Load	Without rests	With rests	Difference	Without rests	With rests	Difference
35 per cent.	7·81 miles	8·59 miles	0·78 miles	8·9 miles	8·9 miles	0·00 miles
40 ,,	7·93 ,,	8·82 ,,	0·89 ,,	8·4 ,,	8·47 ,,	0·07 ,,
45 ,,	8·45 ,,	8·65 ,,	0·20 ,,	8·32 ,,	8·47 ,,	0·15 ,,

TABLE XVII.—MARCHING TO EXHAUSTION. RICHARDSON.

	With rests: five min. after first sample; ten min. after third sample			Without rests		
Total weight in kilos ..	95·18	98·2	102·2	95·18	98·2	102·2
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation, litres per minute	26·30	25·71	28·44	32·34	23 70	35·03
	26·62	25·02	29·21	31·03	24·61	31·77
	27·59	22·82	27·47	27·32	24·36	31·64
	27·51	23·02	25·68	25·64	23·88	27·59
	25·69	20·37	25·75	23·67	20·98	25·74
Average gross.. ..	26·74	23·39	27·31	28·00	23·51	30·35
Less resting value ..	6·12	5·25	5·56	6·71	6·27	5 19
Average net	20·62	18·14	21·75	21·29	17·24	25·16
Oxygen intake in c.c. per minute	1,561	1,332	1,686	1,673	1,421	1,848
	1,539	1,237	1,793	1,545	1,400	1,784
	1,402	1,226	1,610	1,355	1,349	1,593
	1,450	1,273	1,715	1,287	1,258	1,520
	1,369	1,154	1,604	1,198	1,129	1,504
Average gross.. ..	1,464	1,244	1,681	1,412	1,311	1,650
Less resting value ..	334	260	301	306	328	296
Average net	1,130	984	1,380	1,106	983	1,354
Calorie cost per minute	7·421	6·545	8·052	8·010	6·748	8·964
	7·375	6·126	8·409	7·429	6·659	8·587
	6·733	6·003	7·551	6·531	6·487	7·831
	6·952	6·221	8·036	6·114	6·063	7·435
	6·536	5·569	7·516	5·748	5·389	6·879
	7·003	6 093	7·913	6·767	6·269	7·939
	1·581	1·265	1·410	1·472	1·550	1·387
	5·422	4·828	6·503	5·295	4·719	6·552
Calorie cost per sq. metre per minute average	2·932	2·638	3·514	2·864	2·581	3·536
Grm. calories per kgm. (total weight)	0·63	0·56	0·64	0·69	0·57	0·74
	0·62	0 53	0·70	0·65	0·57	0·71
	0·57	0·53	0·66	0·59	0·56	0·66
	0·60	0·54	0·70	0·55	0·55	0·66
	0·58	0·52	0·68	0·53	0·49	0·62
	0·60	0·53	0·67	0·60	0·55	0·68
Grm. calories per kgm. per sq. metre average	0·324	0·286	0·362	0·324	0·297	0·367

The rest periods were five minutes after twenty minutes marching, and ten minutes after eighty minutes from the start of the march. Table XIX gives the rate in metres per hour at the times at which the sample of the expired air was collected. The first sample was collected fifteen minutes after start of march and the others at regular intervals of thirty minutes thereafter. The average rate in metres per minute at these periods was as follows:—

	RICHARDSON		CAMPBELL	
Load	Without rests	With rests	Without rests	With rests
35 per cent	92·39 metres	95·79 metres	93 90 metres	97·77 metres
40 ,,	87·89 ,,	92·22 ,,	90·34 ,,	92·87 ,,
45 ,,	95·33 ,,	94·92 ,,	90·79 ,,	91·61 ,,

It will be noted that the two subjects differed definitely in their mode of progression both in the marches "with" and "without" rests. Richardson, for example, with the forty-five per cent load progressed very rapidly. This was not because he found this particular load easiest to carry

TABLE XVIII.—Marching to Exhaustion. Campbell.

	With rests: five min. after first sample; ten min. after third sample			Without rests		
Total weight in kilos ..	91·5	94·9	98·3	91·5	94·9	98·3
Load in percentage of body weight	35 per cent	40 per cent	45 per cent	35 per cent	40 per cent	45 per cent
Ventilation, litres per minute	23·12	23·83	25·60	22·40	23·53	26·23
	23·74	25·15	25·16	25·93	22·45	24·98
	24·70	21·79	25·74	25·04	21·72	25·72
	24·75	24·31	25·56	25·43	21·12	26·05
	26·12	23·10	25·36	28·43	23·01	24·01
Average gross	24·49	23·64	25·48	25·44	22·37	25·40
Less resting value ..	5·61	5·86	5·66	5·93	5·59	6·04
Average net	18·88	17·78	19·82	19·51	16·78	19·36
Oxygen intake in c.c. per minute	1,327	1,216	1,388	1,310	1,231	1,406
	1,378	1,259	1,385	1,293	1,200	1,371
	1,432	1,289	1,356	1,269	—	1,312
	1,374	1,231	1,345	1,336	1,203	1,405
	1,428	1,146	1,447	1,426	1,223	1,371
Average gross	1,388	1,228	1,384	1,327	1,214	1,373
Less resting value ..	304	286	293	301	280	332
Average net	1,084	942	1,091	1,026	934	1,041
Calorie cost per minute	6·435	5·510	6·774	6·315	6·032	6·857
	6·687	6·215	6·735	6·353	5·850	6·743
	6·919	6·239	6·599	6·218	—	6·423
	6·649	6·016	6·446	6·487	5·812	6·788
	6·872	5·553	6·867	6·900	6·925	6·520
Average gross	6·712	5·907	6·684	6·455	6·155	6·666
Less resting value ..	1·467	1·395	1·429	1·472	1·368	1·594
Average net	5·245	4·512	5·255	4·983	4·787	5·072
Calorie cost per sq. metre per minute average	2·962	2·644	2·988	2·824	2·450	2·868
Grm. calories per kgm. (total weight)	0·57	0·53	0·59	0·57	0·54	0·57
	0·59	0·55	0·59	0·58	0·52	0·55
	0·61	0·55	0·57	0·54	—	0·55
	0·58	0·53	0·56	0·60	0·58	0·59
	0·60	0·48	0·61	0·62	0·53	0·58
	0·59	0·53	0·58	0·58	0·54	0·57
Grm. calories per kgm. per sq. metre average	0·333	0·299	0·327	0·327	0·305	0·322

as reference to his record of subjective symptoms (see Appendix A) shows. There is also a definite although small difference in the average metre rate per minute between the "without" and the "with" rest experiments with both subjects. Thus with Richardson the average rate per minute without

rests was 91·87 metres, and with rests 94·31 metres, and with Campbell 91·68 metres without rests and 94·08 metres with rests.

When the total distance covered in the whole march is considered, it will be noted that with Richardson there is a definite gain in the total average distance covered of 0·62 miles in the "with rest" marches, the gain being curiously enough most marked with the lighter loads, whereas in the case of Campbell the total average gain from rest amounts to only 0·07 mile, the gain being nil with the thirty-five per cent load

TABLE XIX.—MARCHING TO EXHAUSTION; AVERAGES (BOTH SUBJECTS).

Load in percentage of body weight	35 per cent		40 per cent		45 per cent		35 per cent		40 per cent		45 per cent	
	With Rests: five min. after first determination; ten min. after third determination						Without Rests:					
Calorie cost per square metre per hour	176·82		158·46		195·06		170·64		150·93		192·12	
Grm. calories per kgm. (total weights)	0·60		0·55		0·62		0·63		0·56		0·66	
	0·61		0·54		0·65		0·62		0·55		0·63	
	0·59		0·54		0·62		0·57		0·56		0·61	
	0·59		0·54		0·63		0·58		0·57		0·63	
	0·59		0·50		0·65		0·58		0·51		0·60	
	0·60		0·53		0·63		0·59		0·55		0·63	
Grm. calories per kgm. per sq. metre	0·328		0·292		0·344		0·325		0·301		0·344	
	R.	C.	R.	C.	R.	C.	R.	C.	R.	C.	R.	C.
Rate of marching, metres per hour	5859·6	5762·1	5761·4	5577·5	6066·0	5578·0	5961·6	5576·5	5667·0	5489·4	6066·0	5699·3
	5961·6	5862·6	5667·0	5577·5	5862·0	5488·9	5859·6	5576·5	5486·7	5403·5	5959·8	5488·9
	5761·8	5862·6	5486·7	5577·5	5486·7	5578·0	5486·7	5678·5	5401·8	5403·5	5761·4	5403·9
	5667·0	5862·6	5667·0	5489·4	5575·8	5488·9	5318·4	5576·5	5010·0	5316·0	5575·8	5403·9
	5486·7	5980·4	5083·2	5489·4	5486·7	5348·9	5092·8	5762·1	4800·6	5489·4	5238·0	5240·1
	5747·3	5866·1	5533·1	5542·3	5695·4	5496·5	5543·8	5634·0	5273·2	5420·3	5720·2	5447·2
Grm. calories per metre per square metre	32·32	29·23	29·73	25·01	36·40	32·48	35·56	29·43	29·74	28·80	40·51	31·30
	31·53	30·18	27·81	29·29	38·72	32·76	32·97	29·67	30·19	28·11	39·18	31·79
	28·99	31·52	28·01	29·43	36·39	31·41	29·90	28·33	29·74	—	36·27	30·29
	30·73	29·96	28·37	28·53	39·16	31·79	28·30	30·59	29·21	28·33	35·17	32·58
	29·38	30·63	27·45	25·67	36·10	34·46	27·23	31·93	25·93	34·31	34·01	31·86
	30·59	30·30	28·27	27·59	37·35	32·58	30·79	29·99	28·96	29·89	37·03	31·56
Grm. calories per metre per square metre, average	30·45		27·93		34·96		30·39		29·43		34·30	

and greatest with the forty-five per cent load. The difference in result lies without doubt in the difference in temperament of the two subjects. Richardson is a thin, wiry, rather high-strung subject, capable of immense bursts of speed, whereas Campbell is of the more solid, dogged type capable of carrying out a prolonged exhaustive march at a uniform pace. The difference between the two subjects was perhaps most pronounced in the nature of their paces during the course of the march. Both subjects started off at their normal pace, but whilst that of Richardson tended to steadily

accelerate and shorten, that of Campbell remained remarkably uniform from start to finish.

As regards the results when the ventilation rate per minute is considered it will be noted in the case of Richardson (Table XVII) that in the whole series of observations there is a definite tendency, sometimes quite marked, for the ventilation rate to fall as the march progressed, whereas Campbell (Table XVIII) does not show this general tendency, the rate remaining approximately constant or even tending to rise. Both sets of experiments, however, agree definitely in showing that both in the "with" and "without" rest marches the ventilation reaches its lowest level with the forty per cent load. In no instance does the ventilation rate of the 40 per cent load exceed either the rate with the 35 per cent or the 45 per cent load in Richardson, and with Campbell, although in two or three instances it does slightly exceed the 35 per cent load, in no case is it greater than that of the 45 per cent load.

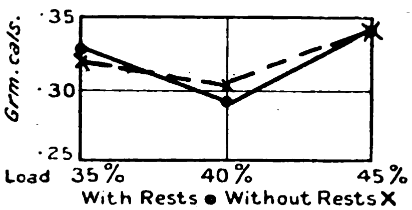


Fig. 11.

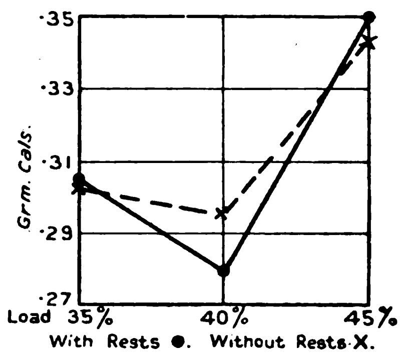


Fig. 12.

Fig. 11.—Marching to Exhaustion. Grm. calories per kgm. per square metre.
Fig. 12.—Marching to Exhaustion. Grm. calories per metre per square metre.

In the case of the oxygen intake there is quite definitely a smaller intake with the forty per cent load. It is also of some interest to note that the oxygen intake in the "without rest" marches is quite definitely below that of the "with rest" marches. Whether this apparently anomalous result is due to the fact that when really tired it is more trying to the subject to restart marching after a period of rest than it is to keep straight on at the set pace doggedly trying to last out the series aided by the rhythm of the movement, such as it is.

The calorie output follows very closely the curve of the output of oxygen.

When the cost in gramme calories per horizontal kilogrammetre and per metre are considered (see Table XIX) it will be noted (*a*) that the cost for the transport of the total weight in gramme calories per horizontal kilogrammetre varies but little in both sets of experiments and that in both

instances the lowest value is attained with the forty per cent load, and (*b*) that if the cost be reckoned in gramme calories per metre (1) there is very little difference between the two subjects except in the case of the forty-five per cent load when Richardson is much higher than Campbell both in the "with" and "without rests" experiment, and (2) that here again in both sets of experiments the result is most definitely in favour of the forty per cent load. (See figs. 11 and 12.)

(6) *Vital Capacity.*

A series of tests were carried out on the subject with reference to the influence of the load on the vital capacity. This test was carried out by making the subject expire to his maximum capacity through a carefully graduated Boulitte spirometer. In carrying out the tests two series were

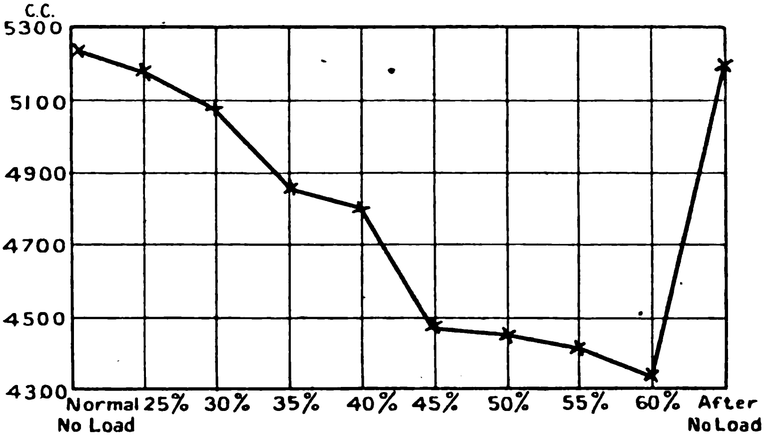


FIG. 13.—Vital Capacity. Richardson.

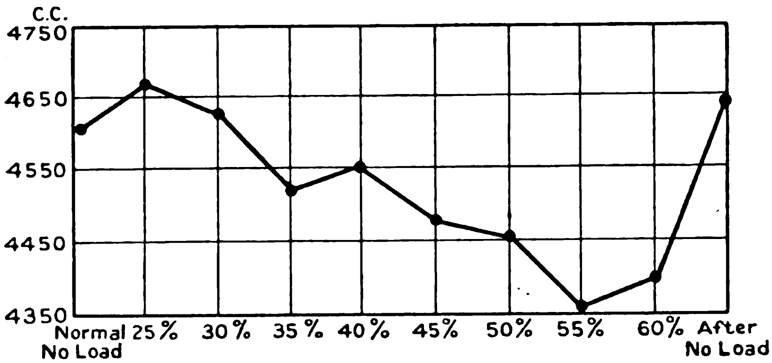


FIG. 14.—Vital Capacity. Campbell.

done on each subject, the subject standing upright throughout the experiment in such a position that he could not observe the result until the "blow" was completed. Series I. The subject did normal tests then

donned the equipment loaded to the equivalent of twenty-five per cent of his body weight. As soon as the equipment was comfortable he carried out as as a rule three vital capacity tests. An interval of three minutes was allowed to elapse between each "blow." Weights were then added to his equipment to bring it up to thirty per cent of his body weight and other three tests of his vital capacity were carried out. The additions of load and determinations of vital capacity were repeated until in the final test the load carried was equal to sixty per cent of the body weight of the

TABLE XX.—VITAL CAPACITY. D. T. RICHARDSON.

Load	Three excessive "blows" 3 min. between each "blow." Capacity in c.c. (1)	(2)	(3)	Maximum capacity	Average capacity	Blood pressure in mm. Hg. (1)	(2)	(3)	Average blood pressure
Normal, without load, before	5,200	5,300	5,300	5,300	5,270	—	—	—	—
Wearing tunic and belt	5,190	5,220	5,000	5,220	5,140	—	—	—	—
Wearing tunic, belt and British Warm	4,700	4,800	4,750	4,800	4,750	—	—	—	—
Equipment = body weight—25 per cent	5,200	4,990	—	5,200	5,100	—	—	—	—
30 ,,	5,000	5,200	—	5,200	5,100	—	—	—	—
35 ,,	4,760	4,600	—	4,760	4,680	—	—	—	—
40 ,,	4,860	4,550	—	4,860	4,720	—	—	—	—
45 ,,	4,410	4,330	—	4,410	4,370	—	—	—	—
50 ,,	4,250	4,370	—	4,370	4,310	—	—	—	—
55 ,,	4,220	4,460	—	4,460	4,340	—	—	—	—
60 ,,	4,000	3,990	—	4,000	3,990	—	—	—	—
Normal after	5,200	—	—	5,200	5,200	—	—	—	—
Normal, without load, before	5,300	5,090	5,250	5,300	5,210	109	—	—	—
Wearing tunic and belt	5,010	4,950	5,020	5,020	4,990	—	—	—	—
Wearing tunic, belt and British Warm	4,970	5,210	5,010	5,210	5,060	—	—	—	—
Equipment = body weight—60 per cent	4,820	4,440	4,810	4,820	4,690	117	121	123	120
55 ,,	4,510	4,430	4,400	4,570	4,470	124	130	132	129
50 ,,	4,530	4,460	4,770	4,770	4,590	132	130	132	131
45 ,,	4,620	4,700	4,400	4,700	4,570	132	134	132	133
40 ,,	4,970	4,880	4,770	4,970	4,870	133	130	120	128
35 ,,	4,830	4,940	5,260	5,260	5,010	128	128	129	128
30 ,,	5,140	4,900	5,130	5,140	5,060	126	125	126	126
25 ,,	5,350	5,160	—	5,350	5,260	125	122	121	123
Normal after	5,200	—	—	5,200	5,200	116	112	—	114

subjects. Series II. A similar set of tests were carried out with gradually decreasing loads, i.e. the test, after the normals were done, started with the sixty per cent load and was finished with the twenty-five per cent load. The rest of the experiment was carried out as in Series I. At the end of each series the normal capacity, i.e., the capacity of the subject without load, was again tested. The results of these experiments on both subjects will be found in Tables XX and XXI. It will be noted from these tables, particularly that of the average results Table XXII and from the graphs figs. 13 and 14, there is undoubtedly a definite diminution in the vital capacity of both subjects with increasing loads. In the case of Richardson

there is, too, a most definite drop in the capacity of the lungs between the loads equal to forty and forty-five per cent of the body weight. It is interesting to note that the respiratory rate was not influenced at all by the alteration of the load carried.

In addition to these observations on the capacity of the lungs, observations on the influence of the load on the blood-pressure were made in both series on Campbell and in one of Richardson's (a few were made during the course of the other).

TABLE XXI.—VITAL CAPACITY: W. CAMPBELL.

Load	Three successive "blows," 3 min. between each "blow" Capacity in c.c. (1)	(2)	(3)	Maximum capacity	Average capacity	Blood pressure in mm. Hg. (1)	(2)	(3)	Average blood pressure
Normal, without load, before	4,670	4,540	4,630	4,670	4,610	120	—	—	120
Wearing tunic and belt	4,420	4,520	4,510	4,520	4,480	—	—	—	—
Equipment = body weight—25 per cent	4,570	4,670	4,480	4,670	4,570	125	126	123	125
30 ,,	4,720	4,550	4,680	4,720	4,650	127	122	124	124
35 ,,	4,440	4,560	4,560	4,560	4,520	127	123	118	123
40 ,,	4,490	4,440	4,490	4,490	4,470	126	124	125	125
45 ,,	4,430	4,420	4,460	4,460	4,440	125	125	126	125
50 ,,	4,310	4,390	4,550	4,550	4,420	127	128	127	127
55 ,,	4,010	4,380	4,430	4,430	4,270	128	127	126	127
60 ,,	4,410	4,430	4,350	4,430	4,290	130	130	130	130
Normal after	4,600	4,650	4,770	4,770	4,670	120	—	—	120
Normal, without load, before	4,560	4,720	4,560	4,720	4,610	116	—	—	116
Wearing tunic and belt	4,540	4,590	4,460	4,590	4,530	—	—	—	—
Equipment = body weight—60 per cent	4,430	4,370	4,470	4,470	4,420	126	130	130	129
55 ,,	4,590	4,480	4,320	4,590	4,460	130	130	128	129
50 ,,	4,510	4,550	4,470	4,550	4,510	128	126	126	123
45 ,,	4,550	4,570	4,460	4,570	4,530	124	122	120	122
40 ,,	4,570	4,580	4,750	4,750	4,630	120	121	118	120
35 ,,	4,490	4,530	4,550	4,550	4,520	120	120	120	120
30 ,,	4,660	4,600	4,600	4,660	4,620	119	114	114	116
25 ,,	4,690	4,970	4,690	4,970	4,780	115	113	113	114
Normal after	4,610	—	—	4,610	4,610	110	—	—	110

It will be observed from Tables XX and XXI that in the case of Campbell there is a very definite upward tendency of the blood pressure, due almost certainly to the compression of the chest, as the load increases. With Richardson, the more highly strung subject of the two, the results are more irregular although the general tendency is the greater the load the higher the blood-pressure.

Zuntz and Schumburg in the course of their experiments carried out a number of observations both on the vital capacity and the effect on the heart. They found there was a definite reduction in the vital capacity of their subjects when carrying 22, 27 and 31 kilos, loads which were approximately 31 per cent, 38 per cent and 44 per cent, of the body weight.

As regards the effect on the circulatory system the methods available for investigation were very limited, but from their study of the pulse

particularly they came very definitely to the conclusion that the heavier loads were a distinct menace to the maintenance of normal cardiac activity.

TABLE XXII.—VITAL CAPACITY.

Average Result with W. Campbell.

	Vital capacity in c.c.	Blood pressure in mm.
Normal before	4610	118
,, tunic and belt	4510	—
Equipment and 25 per cent B.W.	4670	120
30 ,,	4630	120
35 ,,	4520	122
40 ,,	4550	123
45 ,,	4480	124
50 ,,	4460	125
55 ,,	4360	128
60 ,,	4400	130
Normal after	4640	115

Average Result with D. T. Richardson.

	Vital capacity in c.c.	Blood pressure in mm.
Normal before	5240	—
,, tunic and belt	5070	—
,, ,, ,, and British warm	4910	—
Equipment and 25 per cent B.W.	5180	—
30 ,,	5030	—
35 ,,	4850	—
40 ,,	4800	—
45 ,,	4470	—
50 ,,	4450	—
55 ,,	4410	—
60 ,,	4340	—
Normal after	5200	—

(7) *Pulse Rate and Blood Pressure.*

We carried out in addition to the above-mentioned observations a series of observations on the effect of marching and rest pauses on the pulse rate and blood pressure during the experimental marches detailed in Tables XII to XV. A summary of these values is given on next page.

The resting pulse and blood pressure was taken while the subject was in the lying position after the determination of the resting metabolism. The subject, as a rule, during the rest period, in the course of the march, lay down for this time and the pulse was taken immediately he lay down and just before the rest terminated. The post-march pulse rates and pressures were determined at the conclusion of the march after the subject had freed himself from his equipment. The blood pressure was determined by an ordinary tycos sphygmomanometer. Unfortunately the number of observations made are few in number, but as our primary object was the determination of the metabolic cost of such marches we did not devote our attention particularly to this subject.

It is obvious from the figures of Richardson that the pre-march resting

values both as regards pulse and pressure are low and uniform. Campbell's basal values are also reasonably constant although at a higher level. Certainly as regards the observations of the pulse during the rest period, in the course of the march, it is obvious that with perhaps the exception of the march at 125·3 metres per minute which was very trying, Richardson's pulse rate bears little or no relation to the speed of the march. Campbell, on the other hand, who, although very fit, did not engage in any muscular exercise outside the laboratory, shows a pulse rate during the rest period which is undoubtedly influenced by the rate of the march—there is a progressive rise in the pulse with the increase of the march rate. His pulse, in contra-distinction to that of Richardson, shows no tendency to fall below the pre-march resting value. As regards the post-march values, in the case of Richardson, there is little or no effect of the exercise on the pulse rate, but there is a small but quite definite increase in the blood-pressure. The most definite change occurs with the exhausting march at 125·3 metres per minute. In the case of Campbell there is a slight increase in pulse rate over the pre-march resting value, but a definite tendency to be below the rest period record. The post-march blood pressure value varies but little, on the average, from the pre-march values.

PULSE RATE AND SYSTOLIC BLOOD PRESSURE.

Subject	Rate of march metre per min.	Duration of rest	Before march		Start of rest	End of rest	1 min. after end of march		8 mins. later	
			Pulse	B.P.	Pulse	Pulse	Pulse	B.P.	Pulse	P.B.
R.	58·3	0	51	100	—	—	66	112	58	112
	63·6	5	58	—	68	66	52	114	48	110
	70·0	10	61	104	56	56	54	122	51	122
	77·8	15	57	108	54	57	53	116	52	108
	87·5	20	59	110	59	56	56	112	51	112
	83·5	0	53	108	—	—	53	118	56	110
	91·5	5	53	105	60	52	54	112	50	110
	100·2	10	53	100	57	49	55	110	50	101
	111·3	15	—	—	—	—	—	—	—	—
	125·3	20	53	110	85	62	68	120	61	114
C.	58·3	0	74	106	—	—	58	110	56	110
	63·6	5	65	114	62	59	64	123	62	114
	70·0	10	68	114	61	58	70	115	61	115
	77·8	15	69	110	69	64	64	110	57	110
	87·5	20	66	122	74	65	71	112	66	112
	83·5	0	62	110	—	—	64	110	59	113
	91·5	5	67	109	80	76	78	114	70	110
	100·2	10	70	110	88	80	84	120	80	108
	111·3	15	—	—	—	—	—	—	—	—
	125·3	20	57	109	123	96	110	116	92	101

AVERAGE VALUES ALL MARCHES. PULSE RATE AND BLOOD PRESSURE.

	Before march		Start of rest	End of rest	1 min. after end of march		8 mins. later	
	P.	B.P.	P.	P.	P.	B.P.	P.	B.P.
R.	55·3	105·6	62·7	57	56·8	115	53	111
C.	66·4	111·5	79·6	71	74	114·4	67	110·3

This small table of average values of the marches at all speeds brings out very definitely the differences between the two subjects. It will be

noted that in the particularly well-trained subject, Richardson, that there is but little change in the pulse rate, that such strain as the subject has to meet is dealt with by a slight rise in the blood pressure, whereas in the less well-exercised subject, Campbell, although there is but little alteration in the blood pressure, the strain, such as it is, is apparently met by a rise in the pulse rate.

V.—Conclusions.

We think that as the result of our investigation we can claim to have shown fairly definitely that the maximum economic load, under laboratory conditions, which the soldier can carry with a relatively low expenditure of energy is one which is approximately equal to forty per cent of the body weight. See particularly figs. 1, 2, and 3. If we reduce this percentage to terms of load in reference to the average body weight in our Army, about 135 pounds (see p. 438) it would mean that the maximum weight to be added to the nude subject would be about fifty-four pounds. If between 13 and 14 pounds be allowed for the weight of the soldier's clothing, boots, etc., we are left with about 41 pounds available for actual equipment.

It must not be forgotten that these weights have been determined under laboratory conditions where everything is in favour of the test subject—an even walking surface with good foot grip and full protection from the weather and with well fed, well rested, physically fit subjects. The conditions under which the equipment is usually carried are however very different—unequal surface of varying quality and, according to the weather and the nature of the country, of very varying foot grip and subjects varying widely in their physical and psychical fitness. Further accretion of mud and soaking with rain can give a very material addition, as already pointed out (pp. 437-438) to the load carried.

We are therefore quite prepared to give our adherence to the more or less traditional statement, based, no doubt, on long practical experience in the field, that a load equal to one-third of the body weight is the maximum which a fighting soldier should be asked to carry. Calculated on the above standard this would mean a *total* load added to the nude 135 pounds body weight of some forty-five pounds.

This fact is of very great importance, as, when all is said and done, "Infantry is the arm which in the end wins battles" (F. S. Regs. II, p. 22). But infantry must above all things be in good physical condition. "Infantry is still the only arm which can complete a victory and consolidate and hold the ground won" (F. S. Regs. II, p. 168). Further, infantry must be mobile; "Success must be followed up until the enemy's power is ruined" (F. S. Regs. II, p. 200). In the "Manual of Infantry Training I," it is stated that "the military spirit of troops is reduced by excessive fatigue; fatigue can be reduced only by careful training." It is not however a mere matter of training.

The weight of the equipment issued to the men is more or less uniform,

there may be an average weight for a battalion or an army, but the chances that any two men in a battalion are identical in weight, height and physique are negligible.

The strength of a chain is that of its weakest link. Training will do, it is true, a very great deal to obviate much of the fatigue, but training alone will not do away with the ill effects of excessive loads under field conditions. The load must be such that the weakest link in the chain is not rendered ineffective when called upon to perform the duties of an infantry soldier in the field.

It is not within our province to discuss how the necessary load which must be carried by the soldier should be made up, but as it would seem to be essential that every soldier should be equipped with a rifle and a certain amount of ammunition, a small box respirator, a shrapnel helmet, water bottle and emergency rations, it is evident that any reduction which has to be made must fall on the remainder of the equipment as at present laid down. We think, if we may be permitted to make the suggestion, that the heavy greatcoat, which is also a sponge, might be the first portion of the clothing to be dispensed with in a war equipment and a more effective and lighter substitute provided.

Our results also demonstrate very clearly (see figs. 6 and 7) that the maximal economic velocity in our experiments agrees very well with that determined elsewhere, namely, marching at a rate of about eighty metres per minute.

We end where we began. War is not merely the winning of battles; the men must be kept in the field, well fed and healthy, and casualties must be made good. In other words the General Staff may devise the plans which lead to victory but the weapon is supplied and kept medically fit by the Adjutant-General and fed and equipped by the Quartermaster-General. If the costly weapon—man—is to be used effectively and economically, he cannot be overloaded without casting an undue strain both upon the man himself and upon the Supply Services who have to make good the personal and material losses.

We should like to record our deep indebtedness to Miss E. M. Bedale and to thank her warmly for the very freely rendered assistance she gave us in the experimental work.

APPENDIX A.

Subjective Symptoms: D. T. Richardson.

Thirty-five per cent body weight. Without rests. September 6, 1921.

After marching fifteen minutes my neck began to ache. After forty-five minutes I first began to feel my shoulders, and eased the drag by pulling on the braces in front. I began to perspire freely, the day being a close, hot one—65° F.

The ache in my shoulders gradually increased and was particularly

acute on changing the Douglas bags, when I had to move them about. After one hour I commenced relieving weight on shoulders by lifting pack with hands behind and continued off and on like this to the end. My feet became very tender and sore walking in the hard passage. The whole marching was monotonous and boring in the extreme. It was impossible to apply my thoughts to any subject for long, the only fixed idea I had was "How much longer to go?" As the marching progressed I became more and more irritable in temper and I felt my body inclining forward.

Post-march Symptoms.—My shoulders ached all night and I felt very tired. Next day I was still weary and not in any mood to work. Feet still sore.

Thirty-five per cent body weight. With rests. September 8, 1921.

I did not feel any pain at the back of my neck during any part of the march. I did not feel I actually required a rest after twenty minutes' marching but did so lying flat on the floor for five minutes with all equipment off. On restarting I did not feel as if I had done any carrying.

After one hour I began to feel my shoulders slightly but not to any great extent. I never required to ease the weight either by pulling on the braces in front or lifting the weight behind. My feet, however, were sorer as they had not recovered from the last march. After one hour twenty minutes, I lay flat on my back with arms outstretched and all equipment off for ten minutes, I was moist and clammy all over as the room was stuffy so that I was not as refreshed as I would have been in the open air. I felt the better for the rest although I was a bit stiff in the legs and sore of foot, my shoulders were easy and I soon got into my stride again.

After twenty minutes further marching, my shoulders recommenced aching but just moderate discomfort. I was able to swing my arms the whole time. At the end I was a bit giddy with the monotony of it all and very sore of foot which hindered my speed. When I got home my feet were all blistered, my limbs ached a bit but the shoulders were free from discomfort.

Forty per cent body weight. Without rests. September 9, 1921.

I felt tired from the commencement and did not seem to have any spring. Probably stale from the four previous experiments.

After the first forty-five minutes my shoulders began to ache and by the finish they were almost unbearable. My feet were sore and on removing one of my shoes found one of my toes bleeding freely.

The symptoms were the same as with the thirty-five per cent load but exaggerated. The onset of weariness is insidious and the slowing of one's pace is imperceptible. It is impossible to force the pace once settled down to a steady tramp. Thoughts at the end (last hour or so) are solely on how much longer to go, and if it is possible to stick it out. On being

relieved of the weight I felt very dicky and slowly recovered but I was glad to have a lift in C.'s car home.

Forty per cent body weight. With rests. September 23, 1921.

All week I felt the results of the last experiment, and I was not feeling quite recovered when I started to-day in spite of the four days' interval. I marched with light shoes instead of heavy nailed brogues. My feet were not so tender at the end. I think being light-shod made a difference in the length of my stride. It appeared to be shorter.

Symptoms to-day were much the same as other days. However, I felt I was going steadier, and the rests bucked one up a lot. I finished in a better condition than the last day (forty per cent without rests). I could not have done another half hour.

The strain of carrying such a load not distributed equally over the body is considerable. The gnawing pain of the weight between the scapulæ is almost unbearable.

The temperature has been cool lately. No sweating.

The decrease in the rate of marching was not perceptible to me.

Forty-five per cent body weight. Without rests. September 12, 1921.

The floor was very slippery, and for the first few rounds before sand had been sprinkled I had difficulty in keeping my feet. I felt the weight very much more than the thirty-five per cent load. My shoulders began to ache after forty minutes, and shortly after I commenced gripping the braces in front, and from then on I kept shifting my arms to find relief from the pressure pains.

My feet got very sore, especially the left, which produced a large blister, but my shoulders ache downed all other pains and discomforts. I felt very weary at the end and could not have faced any more than I was doing. All evening my shoulders gave me intense discomfort, and were very tender on pressure. Feet were also painful. The day was cool, and I did not sweat much.

Forty-five per cent body weight. With rests. September 14, 1921.

My feet and shoulders were still tender from the last experiment. I kept going well, and after the first rest of five minutes I felt fairly fresh. About the end of the first hour I began to have trouble with my shoulders. I tried every possible way to relieve the pain. The ten minutes' rest was a great ease and relief to both shoulders and limbs. On recommencing, I felt slightly giddy when erect, and my feet were exceedingly sore, and cramped my style a lot at first, but when sufficiently warmed up I began to forget about them and pay more attention to the ache of my shoulders.

I felt after the ten minutes' rest I was doing better time than in the

hour before the rest, and altogether felt fresher, but greatly relieved to get the weights off when I felt the curious sensation of my shoulders shooting up to the ceiling. Feet very sore. Had a painful journey home.

Post-marching symptoms: Bad night, restlessness, constantly waking. Felt very sore and weary next day.

II.—*Subjective Symptoms: Marching at Varying Rates.*

The slower one marched the more the discomfort and weight of load was obvious.

When marching fast, the pressure pains were almost absent; any pains present were in the extensor muscles of the thighs.

The fastest rate, 120 yards per minute, was far more trying than any of the lower rates. The slowest rate, apart from being more monotonous and being associated with great bachache, was least fatiguing of all.

APPENDIX B.

SUBJECTIVE SYMPTOMS: W. CAMPBELL.

Thirty-five per cent body weight. Without rests. September 27, 1921.

Realized within ten minutes of the start that there was going to be trouble with my right shoulder, as the weight was not evenly balanced.

In about twenty minutes there was some distinct discomfort in the right shoulder. The discomfort increased, and shortly developed into pain. The pain, however, was not unbearable, and was made more tolerable by keeping the shoulders as square as comparative comfort would permit. At the end of an hour and a quarter's marching I had to ease the discomfort and pain in the shoulders by means of pulling on the braces in front. The left shoulder throughout gave me no trouble at all.

About the same time as I eased my shoulders (i.e., after about an hour and a quarter's march), I began to feel my feet getting sore—a sensation of bruising on the ball of both feet. By the time I had marched for two hours I felt distinctly tired and weary and very very bored.

From the time of taking the fourth sample up to the end of the march, I had to concentrate on keeping up the pace, and to this end I leaned forward. This had the effect of lengthening my stride, and the pace was, if anything, slightly increased when the forward leaning attitude was adopted.

At the end of the march there was considerable pain and stiffness over the scapulæ, but no discomfort in the region of the scaleni. The feet felt bruised and tender on the soles, and there was general fatigue.

After a hot bath and a meal the aches and pains wore off to a considerable extent, and I slept soundly. Next morning there was some stiffness in the latissimus dorsi of the right side and in the smaller gluteal muscles of the same side, generally a little tired, but this wore off by the afternoon.

Thirty-five per cent body weight. With rests. September 29, 1921.

Weight this time evenly balanced, and no stiffness of either shoulder nor fatigue worth mentioning, after twenty minutes' march, when I had my first halt.

The first rest banished all feeling of fatigue, and felt in better form for marching at the end of it than I did at the start of the march.

Began to feel some discomfort in my shoulders after about forty minutes' marching from the re-start after the first rest, and shortly afterwards my feet began to give the old "bruised" feeling.

Consequently I was quite pleased to take my ten minutes' rest, and this relieved my shoulders, but my feet at the resumption of the march seemed more tender than when I stopped for the rest.

After starting again I had been marching for half an hour before my shoulder began to stiffen up again, and my feet became distinctly painful.

I did not feel really fatigued until within half an hour of the end of the march. At the end I was distinctly tired, but not physically "done in." My feet, however, were very sore, and again I was distinctly bored.

Slept well, and practically no stiffness in the morning, and no feeling of tiredness.

Forty per cent body weight. Without rests. October 10, 1921.

Felt load distinctly heavy at the start, but actual feeling of "pulling" on the shoulders did not make itself apparent until I had been marching for quarter of an hour.

Shoulders began to ache very shortly after the first twenty minutes' march, and I had to relieve them by pulling on the braces in front.

After one hour's marching the trapezii over the shoulders became so stiff and painful that I had to support the pack with my forearms behind in order to get relief. When the arms got tired of supporting the pack behind, I held on to the braces in front. By alternating these two methods of support I seemed to minimize the discomfort, until the last half hour, when the pull of the load and the weight made themselves increasingly felt.

At the end of the march I had had quite enough of it, and was very glad to get rid of the weight.

The last hour, and especially the latter part of it, produced a degree of mental irritability and a feeling of being utterly "fed up." At the end of the march the trapezii were painful and stiff, and I was distinctly tired. The feet were not at all bad, merely a little bruising sensation at the end of the march. The thigh muscles felt tired.

Slept only fairly well, and was still stiff in the shoulders next day, and disinclined to work.

Forty per cent body weight. With rests. December 10, 1921.

Began to feel the pull of the load towards the end of the first twenty minutes.

After five minutes' rest I was quite as fresh as at the original start, but the pull of the load made itself felt again shortly after resuming, and within twenty minutes the shoulders began to ache.

Supporting the braces in front gave sufficient relief, and I did not have to support the pack behind until after the second rest, although the shoulders were distinctly stiff and painful.

I was very glad of the ten minutes' respite, and felt very much the better of it. Shortly after resuming, however, I had to support the braces again, as the shoulders quickly became stiff and painful, and before I had marched for half an hour I had to support the pack behind.

After I had marched for about two hours altogether, I began to feel very weary and tired, and my thighs and legs began to stiffen up. The last half hour was accomplished mainly because I knew it was the last of the march. At the end I felt considerably more fatigued than I had been with any other weight, even without rests, probably due to cumulative action of fatigue.

At night I was restless and slept but brokenly, and next day felt tired and irritable and not inclined to work at all.

Forty-five per cent body weight. Without rests. October 4, 1921.

Felt the pull of the load on my shoulders from the start.

Had to lean forward shortly after the start, as I could not keep my shoulders square with any degree of comfort. The shoulders began to ache after twenty minutes' marching, and after forty minutes' marching I had to support the pack behind with my forearms, to ease the pain in my shoulders.

At the end of an hour the pain in the shoulders was very acute, and even supporting the pack behind did not give proper relief. This acute discomfort, however, wore off gradually and gave place to a more tolerable dull ache in the trapezius muscles over the shoulders and at the root of the neck.

This ache continued throughout the march, and the drag of the load became more and more apparent, but by holding the braces in front and supporting the pack behind alternately, the discomfort was made bearable.

In the last half hour, however, it became increasingly difficult to get relief in any position, and at the end of the march my shoulders were acutely painful.

My feet did not trouble me until after one and a quarter hours' marching, when they began to become painful, but they did not really inconvenince me until the last half hour, when the old bruising sensation became increasingly evident.

At the end of the march I was footsore and distinctly tired. I had no

wish to continue, more especially as my legs began to stiffen up towards the end.

Slept well. Slightly tired and stiff in the morning.

Forty-five per cent body weight. With rests. October 6, 1921.

Felt the pull of the load on my shoulders at once, as before with this weight.

Shoulders not so painful after the first twenty minutes as last day (without rest), but painful enough to make me glad of the five minutes' rest, which made me feel much better.

About quarter of an hour after resuming, my shoulders got pretty painful and I had to support the weight by pulling on the braces in front. This gave me relief. By the time the second rest was due, my shoulders were very distinctly painful and stiff, and I was glad to get rid of the load and rest for ten minutes. Also my feet were just beginning to feel bruised.

The rest greatly refreshed me, but shortly after resuming the march my shoulders again bothered me, and I had to pull on the braces in front.

During the last half hour or so the pull of the load seemed to increase progressively, and I had to support the pack behind to ease my shoulders.

I found I had unconsciously lengthened my stride.

During this time also my feet became worse, and at the end of the march I was distinctly tired, but not nearly so much so as at the end of the march without any rest.

Slept well. Slightly stiff next morning.

REFERENCES.

[1] BENEDICT and CATHCART. Carnegie Inst. Publ., No. 187, Washington, 1913.
[2] BENEDICT, MILES, ROTH and SMITH. *Ibid.*, No. 280, Washington, 1919.
[3] BENEDICT and MURCHHAUSER. *Ibid.*, No. 231, Washington, 1915.
[4] BREZINA and KOLMER. "Biochem. Leitsch." 1912, 38, p. 130.
[5] BREZINA and REICHEL. *Ibid.*, 1914, 63, p. 170.
[6] CAMPBELL, DOUGLAS and HOBSON. *Phil. Trans. Roy. Soc. Lond.*, 1920, ccx B.
[7] CATHCART. JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, November, 1918.
[8] CATHCART, LOTHIAN and GREENWOOD. *Ibid.*, 1920.
[9] CATHCART and ORR. "Energy Expend. Inf. Recruit Training," H.M. Stationery Office, 1919.
[10] DURIG. Denksch. d. math. natur. Klasse d. K. Akad. d. Wissensch., 1909, 86.
[11] DURIG and others. Denksch. d. K. u. K. Akad. d. Wissensch., 1911.
[12] FRENTZEL and REACH. *Pflüger's Archiv*, 1901, 83, p. 494.
[13] HILL, A. V. *Physiolog. Review*, 1922, 2, p. 310.
[14] KROGH and LINDHARD. *Journ. Physiol.*, 1920, 53, p. 431.
[15] LAULANIÉ. "Eléments de Physiologie," Paris.
[16] LILJESTRAND and STENSTRÖM. *Skan. Arch. f. Physiol.*, 1920, 39, p. 167.
[17] LOEWY. "Handbk. d. Biochem." (Oppenheimer), Bd. IV, I, i, Berlin, 1911.
[18] LOTHIAN. Army Hyg. Adv. Committee Report I, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, 1922.
[19] LUPTON. *Journ. Physiol.*, 1922, 56, Proc. xxxii.
[20] PARKER. "Manual of Practical Hygiene," London, 1873.
[21] SMITH. Carnegie Inst. Publ., No. 309, Washington, 1922.
[22] ZUNTZ and SCHUMBURG. "Physiologie des Marsches," Berlin, 1901.

SCHEME FOR AN EXAMINATION OF MAJORS, ROYAL ARMY MEDICAL CORPS, FOR PROMOTION TO THE RANK OF LIEUTENANT-COLONEL, PART II, HELD IN THE ALDERSHOT COMMAND, FEBRUARY, 1923.

By Major-General GUISE MOORES, C.B., C.M.G., K.H.S.
Army Medical Service.

AND

Brevet Colonel W. G. S. DOBBIE, C.M.G., D.S.O.
Royal Engineers; G.S.O. 2nd Division.

(*Continued from p.* 120.)

Situation No. 1. Task No. 1.

Required as A.D.M.S. the assumed position of the medical units 3rd Division and Cavalry Brigade at 12.00 hours, February 12.

This was quite a simple task. The position of the headquarters of medical units only was required. The advanced guards were not finally brought to a standstill till 12.00 hours. The total casualties up to that hour were only 230—no great number for the Divisional main dressing station and W.W.C.S. at Binsted to deal with. It would be a tactical error to immobilize the other field ambulances by allowing them to open and receive wounded before the main body of the Division became engaged. It is considered that para. 1 of 3rd Division R.A.M.C. Orders issued at 22.30 hours February 11 gives an indication of the probable situation of the 7th, 8th, and Cavalry Field Ambulances at 12.00 hours, i.e., before deployment of the main body was contemplated. They would be marching in rear of their respective brigades, less one company from each, with the advanced guards.

Situation No 1. Task No 2.

Required as A.D.M.S. 3rd Division the orders or instructions given the medical units, after it was known that a concerted attack was to take place at 14.00 hours, with a view to obtaining possession of Hungry Hill—Beacon Hill.

It is considered that the 3rd Division R.A.M.C. Orders of February 11 based as they were on intelligence available at the time of issue, made adequate provision to meet all likely medical requirements up to the forenoon of the 12th. As the day advanced, the divisional commander's further orders necessitated additional instructions to field ambulances to meet new developments. The A.D.M.S. 3rd Division then promulgated the following instructions: See F.S. Regs., (Provisional), vol. ii, sect. 67, para. 5.

To Officers Commanding 7th, 8th, 9th, and Cavalry Ambulances.

SECRET. February 12, 1923.

Reference O.S.—One-inch map, Aldershot Command.

(1) General Officer Commanding intends to resume the advance at 14.00 hours to capture Hungry Hill—Beacon Hill.

(2) Nos. 7 and 8 Field Ambulances will collect and receive casualties of 7th and 8th Brigades respectively.

(3) The Cavalry Field Ambulance will transfer all casualties to the main dressing station, No. 8 Field Ambulance.

(4) No. 9 Field Ambulance at Binsted will close when all casualties have been evacuated. At 14.30 hours, one company will proceed to Dippenhall and open a divisional W.W.C.S. Ten lorries will report at W.W.C.S. at 15.00 hours under instructions issued by the D.D.M.S.

(5) Acknowledge.

(6) Reports to A.D.M.S. at Bentley.

Issued at 13.00 hours by S.D.R., headquarters, 3rd Division.

In a war of movement when field ambulances are detailed to advance with troops attacking a distant objective, the Divisional R.A.M.C. Orders should never assign map positions for advanced or main dressing stations. Field ambulance commanders should be well forward, and after making a reconnaisance of the area the troops are advancing over, should select sites suitable for main dressing stations. Officers commanding field ambulances, or the company commanders, should in the same way select sites for advanced dressing stations. In position warfare this rule may require some modification, but even then, the selection of these stations should generally be left to the field ambulance or company commanders. In this particular movement the field ambulances were allotted to the attacking brigades, the medical tactical decisions were therefore left entirely in the hands of the officers commanding those units. The principle conceded was, that it is "usually dangerous to prescribe to subordinates at a distance anything that they should be better able to decide on the spot with a fuller knowledge of local conditions." See F.S. Regs. (Provisional), ch. vi, sect. 67, para. 4.

Field ambulance commanders should detail a liaison officer and motor cyclist for brigade headquarters on such occasions.

As regards the treatment of gas casualties in operations such as are now being considered, it would not be possible to detail any particular unit to act as a divisional gas treatment centre. Each field ambulance should be prepared to treat any gas casualties that found their way to the advanced dressing station that it was clearing. The allotment of one medical unit to deal with all gas casualties wherever they occurred would lead to confusion and delay in treatment of patients.

The D.A.D.M.S. should be in the forward area visiting the main dressing stations and advanced dressing stations, and should report

progress to A.D.M.S. at divisional headquarters. He should be provided with a motor cycle.

SITUATION NO. 2.

(1) The attack of the 3rd Division was successful, and by 16.00 hours Hungry Hill and Beacon Hill were in its possession, and outposts had been pushed forward to the line Westend—Jubilee Hill, Leipzic Barracks —Dares Farm.

The 1st Division had, however, not succeeded in getting beyond the line Hampton Park—Highmill, and the 7th Brigade had consequently to throw back a defensive right flank through Hale to Highmill.

(2) The situation at 18.00 hours was as follows: 7th Brigade group, Hungry Hill—Upper Hale: 8th Brigade group, Cæsar's Camp—Beacon Hill—Redlands—Upper Old Park; 9th Brigade group, in Divisional Reserve about Dippenhall; Cavalry Brigade, Doghersfield Park; Divisional Headquarters, Ridgway House.

(3) Casualties were as follows (in addition to those mentioned in Situation No. 1):—

7th Brigade	...	...	800	= 1,630.
8th Brigade	...	...	650	
9th Brigade	...	...	50	
Cavalry Brigade	...	...	130	

In addition, the 7th and 8th Field Ambulances had lost ten per cent of their bearers.

(4) Divisional Headquarters informed A.D.M.S. at 18.00 hours that probably the advance would be continued next day at 09.00 hours.

SITUATION NO. 2.

Task No. 3.—Medical disposition for night 12/13th.
Task No. 4.—Report (if any) sent to D.D.M.S. Corps.

SITUATION NO. 2. TASK NO. 3.

Required as A.D.M.S., 3rd Division, the medical disposition on the night 12/13th.

The fighting ceased at sunset. The total casualties since noon 12th were 1,630. Assuming that twenty per cent of these were killed, this would leave eighty per cent wounded, making a total of 1,300. Of these twenty per cent were dangerously wounded, i.e., 260; sixty per cent severely wounded; i.e., 780; and twenty per cent lightly wounded, and able to walk, i.e., 260. The walking wounded mostly congregated at the W.W.C.S. at Dippenhall, which was cleared by motor lorries, ten of which were temporarily placed at the disposal of A.D.M.S., 3rd Division, direct to the casualty clearing station at West Meon. The bearers of Nos. 7 and 8 Field Ambulances were reinforced by one company of No. 9 Field Ambulance, but the complete clearance of the battlefield was only

effected by the employment of a company of combatant troops obtained from the 9th Brigade, and all available prisoners of war, by arrangement with "A" branch of the Staff.

The field ambulances were clear of all wounded, and closed ready to move at 23.00 hours on 13th.

The field ambulances were disposed as follows :—

7th Field Ambulance: Reinwick House—three-quarter mile south of the A in Dippenhall.

8th Field Ambulance: at Bentley House—half mile north of the cross roads at Bentley.

9th Field Ambulance (Divisional W.W.C.S.): at Dippenhall.

Cavalry Field Ambulance: Itchel Manor House—quarter mile north of the C in Crondall.

These were all established in positions off the main roads as these were liable to be heavily shelled.

SITUATION NO. 2. TASK NO. 4.

Report from A.D.M.S. 3rd Division to D.D.M.S. Corps :—

To D.D.M.S. Corps.

(1) All field ambulances clear of wounded and closing.
(2) Ten per cent bearer casualties. Am arranging for reinforcements.
(3) Gassed cases all evacuated.
(4) 150 (one hundred and fifty) additional stretchers required.

Sd. A. N. Other,
Colonel, A.D.M.S.,
3rd Division.

By S.D.R., at 22.00 hours, February 12, 1923.
3rd Divisional Headquarters, Ridgway House.

SITUATION NO. 3.

Owing to the heavy losses sustained and to the reported approach of strong enemy reinforcements, the Corps commander on the 13th decided to postpone his further advance until reinforcements, which were expected to arrive in one week, reached him.

He consequently ordered the 3rd Division to consolidate its position and reorganize and rest its men; the 1st Division was to secure the Hog's Back by a night attack on the 13—14th and then consolidate its position.

TASK NO. 5.

What advice as A.D.M.S. would you give the General Officer Commanding 3rd Division?

SITUATION NO. 3. TASK NO. 5.

Owing to heavy losses, the Corps commander decided early on 13th to postpone any further advance until the arrival of reinforcements. The

position gained was to be consolidated and reorganized, and rest given to the men.

Required from A.D.M.S., 3rd Division, the advice given to the G.O.C. under the circumstances.

The following was considered suitable:—

(1) The retention of all light cases in field ambulances beyond twenty-four hours.

(2) Medical inspection of all troops for the detection of infectious diseases, scabies, venereal disease and vermin.

(3) Arrange for bathing, change of underclothing and drying of clothing for all units.

(4) Institute a system of deep trench latrines outside towns, and additional latrine accommodation on the bucket system for towns and villages; and order a rigid inspection of trench and outpost latrines.

(5) Billet as many men as possible under good cover, in houses if possible.

(6) Supply coal or extra fuel to billets.

(7) Draft regulations for the prevention, mitigation and treatment of venereal disease and the control of prostitution.

(8) Issue extra blankets to units in front lines.

(9) Keep men suitably employed with physical drill and start games, concerts, cinemas, etc.

(10) Arrange for hot meals and hot drinks, these to be varied and regularly provided.

(11) Recommend an issue of rum daily at night time.

(12) Police all water supplies.

(13) Place all public houses out of bounds.

Situation No. 4.

(1) During the 14th the enemy retired in a northerly direction and the 1st and 3rd Divisions followed him up, and by nightfall had reached the line, Blackdown, Yorktown, Yateley, in light touch with the enemy.

(2) On the morning of the 15th the situation of the troops was as follows:—

1st Division area: Blackdown, Yorktown, Mytchett, Pirbright.

3rd Division area: Blackwater, Yateley, Fleet, Farnborough.

2nd Division area: Aldershot, Farnham.

Cavalry Brigade area: Eversley, Bramshill.

(3) Strong forces of the enemy being reported to be advancing from the direction of Reading, the Corps Commander decided to withdraw to the line Hindhead, Alton. He also informs the D.D.M.S. confidentially that owing to the situation elsewhere the withdrawal may have to be complete, and Expeditionary Force re-embarked.

The 1st and 3rd Divisions were ordered to remain in present position until the evening of the 16th and to be prepared to fall back during the night of the 16—17th through the 2nd Division (which would be holding

a line from Seale to Beacon Hill), the Cavalry Brigade would cover the left flank during the retirement.

TASK NO. 6.

Arrangements you would make as D.D.M.S.

TASK NO. 7.

What written instructions would you give to A.D.M.S. of Divisions?

Tasks 6 and 7, though separate, are best considered together.

THE ADVANCE.—The enemy's retirement was unexpected and our follow on rapid. By nightfall 14th our advance guards were in touch with him, on the line Blackdown, Yorktown, Yateley.

Arrangements by D.D.M.S.—At 10.00 hours on the 14th he ordered one section of No. 1 M.A.C. and 10 lorries (for walking cases) to report to A.D.M.S. 3rd Division, and one section No. 1 M.A.C. and 10 lorries to A.D.M.S. 1st Division. The Cavalry Field Ambulance to evacuate sick to nearest M.D.S. 3rd Division. At 10.00 hours 14th, the light sections of Nos. I and 2 Casualty Clearing Stations were ordered to proceed by lorry transport from West Meon to Farnham, open there and deal with all casualties of the Force. All casualties to be evacuated from Farnham by No. 3 Section, No. 1 M.A.C., and No. 1 Section, No. 2 M.A.C. (brought up from the base) and twenty lorries for light cases, to West Meon, heavy section Nos. 1 and 2 Casualty Clearing Stations to be responsible for entrainment. Arranged with R.T.O. at West Meon for one ambulance train to be at that station siding at 14.00 hours on 15th for transfer of casualties to Portsmouth.

The casualties were few in number on the 14th, 15th, and 16th, and were easily dealt with by the Light Sections of Nos. 1 and 2 Casualty Clearing Stations.

THE WITHDRAWAL.—*Arrangements made by D.D.M.S.* The Light Sections of Nos. 1 and 2 Casualty Clearing Stations to close at 12.00 hours on 16th and move by lorry transport to join their headquarters at West Meon.

All casualties of the 1st and 3rd Divisions after this hour on 16th to be evacuated from Field Ambulance M.D.S.'s by arrangements of A.D.M.S. direct to Casualty Clearing Station at West Meon.

Arranged with R.T.O. for No. 3 Ambulance Train to be sent to Farnham by 00.06 hours 17th, to take casualties of 2nd Division, A.D.M.S. to arrange entrainment.

All sick and wounded unable to be moved to be transferred to nearest Civil Cottage Hospitals.

Ordered Casualty Clearing Stations at West Meon and Petersfield to be prepared to close at short notice, and move by train to Portsmouth.

Close Advanced Depot Medical Stores at West Meon.

In anticipation of a possible complete withdrawal and re-embarkation of the Expeditionary Force the following additional arrangements were made :—

(1) Nos. 1, 2 and 3 Hospital Ships to be at once employed for evacuation purposes.

(2) All general hospitals at Base to be cleared as far as possible to hospital ships, and convalescent depots to troop transports.

(3) Warn A.D.M.S., Base, that two general hospitals of 1,200 beds and convalescent depots should be closed preparatory to embarkation.

(4) Warn O's.C. Casualty Clearing Station that they may be required to take over buildings vacated by general hospitals.

(5) Arrange for sick and wounded unable to be moved to be taken over by enemy civilian hospital authorities and consider the question of leaving R.A.M.C. personnel behind.

(6) Warn Base Depot Medical Stores to be prepared to close, and instruct O.C. to prepare to leave sufficient medical and surgical material for two weeks' supply for sick and wounded remaining.

(7) Warn O.C. Ambulance Trains to be prepared for transportation overseas.

(8) Warn O.s'C. Pathological and Hygiene Laboratories to be prepared for early embarkation.

TASK No. 8.

Three cases of smallpox are reported on February 13, in different parts of Petersfield.

As D.D.M.S. of the Force what recommendation would you make to the Commander in Chief?

Recommendations.

(1) Place Petersfield out of bounds to all troops.

(2) See that the smallpox cases are efficiently isolated and treated.

(3) Isolate and vaccinate or revaccinate contacts.

(4) Inspect, and if necessary, vaccinate or revaccinate all troops in the Petersfield area.

(5) Inspect all civilians, men, women, and children, for efficient marks of vaccination, and order civilian practitioners to vaccinate and revaccinate those requiring it.

(6) Confine the inhabitants of Petersfield to the town and its precincts.

(7) Keep civilians from other towns out of Petersfield.

(8) Inform G.O.C. that the troops are well protected and that there is no fear of an epidemic.

(9) 6 and 7 would not be carried out unless the disease was taking an epidemic form.

Though this scheme contains some suggested modifications in the existing organization of certain medical units, such as the Field Ambulance, the Cavalry Field Ambulance, the Casualty Clearing Station and the Motor

Ambulance Convoy, these have caused no change in the principles generally advised and adopted for their location and employment in war. The modifications have been made with the object of ensuring to these units increased mobility combined with greater general utility. The following brief notes will explain the scope of the modifications introduced.

(1) *Field Ambulance.*—The new organization, consisting of Headquarters and two companies, is so constituted as to be able to form one main and two advanced dressing stations. Each company will be capable of fulfilling any demands made on the "bearer personnel" and, should only one A.D.S. be required, the other company could remain with its headquarters, sending bearer squads forward as necessary, in addition or relief. Each company is self-contained in every respect and is capable of a separate existence under any circumstances. A travelling kitchen has been added to this unit.

(2) *Cavalry Field Ambulance.*—As now constituted this unit possesses increased mobility. It consists of headquarters and one company. The latter can move and be independent of its headquarters should the occasion arise. Lorries have been allotted for the transport of the personnel and a travelling kitchen provided. The ambulance transport now consists of 4 heavy ambulance cars, 6 light ambulance cars and 6 light horsed ambulance wagons.

(3) *Casualty Clearing Station.*—This unit possesses fifty beds and 150 stretchers, and is divisible into light and heavy sections. The light section has been so organized and equipped that it can be advanced at short notice and either open and carry on the operative duties of the unit or, if required, take over the main dressing station of a field ambulance. Experience in the recent war proved that some ten per cent of the seriously wounded required operative treatment, and the light section has been therefore equipped for fifty patients. The decision as to what proportion of beds and stretchers shall accompany the light section in its forward move is left in the hands of the O.C. unit. The transport required to move the light section should not exceed nine three-ton lorries. The heavy section would join the light section as circumstances permitted. The entire unit has been made mobile and its medical and ordnance equipment adapted to meet the requirements of a war of movement.

(4) *Motor Ambulance Convoys* are organized into three sections, each with twenty-five cars.

HABITS, CUSTOMS AND MODES OF LIFE OF THE NATIVE TRIBES OF BRITISH EAST AFRICA (NOW KENYA COLONY).

By Captain R. L. STANLEY, M.B.E.

(*Continued from p.* 128.)

The Wa-Kavirondo.

The Wa-Kavirondo with its many branches is a populous tribe and inhabits a large territory roughly to the north and south of the Kavirondo Gulf in the Victoria Nyanza, the area to the north extending to the slopes of Mount Elgon and to the south to what was the German border. The tribe is remarkable for the fact that men and women do not wear clothing, adopting the nude totally, except in centres like Kisumu where the merest apology for dress is adopted in the form of a loincloth made from americani (calico). As this hangs loosely over the body front the smallest breeze or movement readily displaces it. It is on record that a certain English lady was so shocked on seeing this people in the nude that she purchased large quantities of americani (cotton cloth) for distribution to at least partially hide their nudity. The gift was readily accepted but failed in the object for which bestowed and its use was soon discarded. On the other hand this nude tribe, or such of its members who enter domestic or other service which demands that dress must be worn, exhibit a marked tendency to dress in the latest obtainable patterns of European outfit. Chiefs and those who have imbibed any smattering of education through mission sources, when going afar are sometimes attired in the latest European cut and style. Of the many tribes in East Africa the Kavirondo possess the finest physique, being tall, erect and well proportioned.

The Nilotic Kavirondo is probably the most numerous branch of the tribe, and according to its custom each wife has her separate hut within a kraal, the senior wife's hut being placed on the right-hand side of the entrance. The husband lives with each wife in turn. The children live with the mother until about 9 years of age, after which the girls are placed with a woman past production, and the boys live apart in a hut termed simba. A community, generally near relatives of each other, occupy the same village of huts, and sometimes several families may live in one village. The huts are built of sticks and mud and thatched with grass. There are no windows or outlets for smoke and only a small opening acts as a door. Villages are built haphazard and not according to any fixed plan. In some instances they are surrounded by a stockade, the cattle being gathered together at night inside the stockade surrounding the huts; in other instances the huts are grouped together without any particular arrangement. Goats, sheep, calves and poultry are housed in

the dwelling huts. Latrine arrangements as in the case of all tribes are conspicuous by their absence.

Any kind of food except hyena flesh is eaten, and the variety includes matama, maize, sweet potatoes, beans, bananas, fish, fowls, meat, milk and vegetables. The chief meal is partaken of in the evening. Men and boys eat together, and women and children together. The father of the family eats alone. Fowls, eggs and mutton are prohibited to young women, and in some districts certain kinds of fish and hippopotamus are tabooed. Drink may be taken with or after food, and one beverage is sour milk mixed with the urine of cattle. Ablutions are seldom performed, and if one is ill it is considered a bad practice to wash.

Intoxicants are made from matama and wimbe, and are used at wedding feasts and in honour of the dead at funeral dances.

Those of the people who have lived on the shores of the Victoria Nyanza and along the banks of rivers, have in the past suffered from the ravages of sleeping sickness. Movement of the natives from the fly-infected areas and other preventive measures adopted on the advice of the Government, have helped to ameliorate this dreaded scourge, until now only a few cases are met with. Whole districts have, in bygone times, been nearly depopulated through sleeping sickness. It has been suggested that a race has been produced in the course of time which to-day is almost immune to the disease. However this may be, the fly which is responsible for conveying the disease is still to be met with and must consequently be guarded against. Unfortunately the native is inclined to look upon disease generally as a necessary evil. They dread plague in a special sense and will evacuate infected huts.

Medicine men are said not to have much influence and do not take any special part in ceremonies. Their domestic remedies are preparations from herbs, roots, etc., and secrecy is maintained in regard to them. There are also witch doctors who, like the medicine men, will not divulge the secrets of their art: the difference between them is that the former are consulted in genuine cases of illness, while the clients of the latter are such as hope to obtain some secret harmful effect on a real or fancied enemy. No system of theology is expounded, but there is a prevalent idea that the sun is God.

The Luo or Nilotic Kavirondo bury their dead within their huts in shallow graves. An unmarried person is buried under the eaves of the mother's hut. The husband is buried inside his principal wife's hut, and should she have predeceased him then he is buried inside the eating hut. Each wife is buried in her own hut. The huts continue to be occupied until the kraal is abandoned; they are not pulled down but allowed to fall into decay. Mourners arrive in relays for a month, during which each relay stamps the earth on the grave and a feast is held during the whole period. The women and children do not cut their hair for three months, after which they shave their heads. Another big dance is then

held, more earth stamped on the grave and then the heir succeeds to the property. There is a belief that the shadow of the deceased inhabits certain trees, but belief in a hereafter is very vague.

Figures for births and deaths are not obtainable, but it is known that the infant mortality is high. There are considerably more girls than boys. Abortion methods are known and applied. A plant called *ohoho* is eaten to bring on abortion. There are not many deaths in childbirth. Children are as a rule fed by the breast for over a year, after which they are fed with cow's milk. After childbirth the mother is up and about again on the fourth day.

Bantu Kavirondo tribes have no virgins by custom. Their girls are deflowered by their young men before marriage. The Nilotic Kavirondo women are virtuous as unmarried virgins, and virtuous as married women with children; where they are not virtuous present-day contamination is responsible.

Contamination with the vices of civilisation has, and will, sadly affect the morality of the Yaluo Kavirondo, but it will not for a long time much affect their mental and physical superiority in the country. The men going out from the lake area to toil abroad do not unfortunately take their women with them, but this may create a new and superior blood-strain as did chief Mumia's indemnity of virgins referred to later.

The Kavirondo labourer is much appreciated in East Africa, and is a sure stand-by to the white settler. At the Coast he is also to be found engaged in many activities.

The tribe differs from others in East Africa by racial origin, customs and social habits, and the Nilotic race is as foreign to the Bantu tribes as a Teuton to a Sicilian.

Chief Mumia, of North Kavirondo, pleaded to the early officials for assistance against the Nilotic Kavirondo who were conquering his lands. The white man helped Mumia to drive them off, and thousands of cattle and hundreds of virgin girls were seized as an indemnity. This did not deter the men from the Nile, for their lost virgins bore children with Kavirondo brains and tendencies, who, though living in Bantu tribes, have helped the peaceful penetration of the Nilotic Yaluo people into the lake areas.

Not so many years ago South Kavirondo dealt a terrible defeat on the Wa-Kisii so lauded as warriors by those who like to praise idle and truculent tribes. The Wa-Kavirondo is disliked by the more idle and less tractable tribes and is spoken of as cowardly. He is, however, no coward, and in the wild country is known to attack and spear lions to death as do the Masai and Nandi.

The Wa-Kisii, Wa-Kitosh and Wa-Tende are called Kavirondo, but they have not much in common with the real North Nilotic Kavirondo. The Kavirondo Gulf earned its name from the Nilotic Kavirondo on its shores. The two districts, North and South Kavirondo, got their names for geographical convenience, and all tribes about were called Kavirondo.

The tribe is amenable to all the white man's colonizing ventures in the supply of labour, and from being so tractable is regarded by the less-informed as servile and cowardly. The Great War in East Africa, in which he was largely employed and engaged, proved him to be calm and indifferent even when under deadly fire.

Following in his proper sphere behind the industrial steps of the white man, he succeeds in the co-operation of his labour with the latter's industries. The non-tractable tribes endeavouring to cling to their old lives of wild and uncivilized days and not so inclined to follow the white man's footsteps, will remain much longer than the Kavirondo in the slough of savagery. The Wa-Kavirondo and the Wa-Swahili tribes are the most tractable in East Africa, but their tribal Ethiopeanism is so impure and their social system so artificial as to render them of no use in the study of primitive Ethiopians.

Tribes on the Northern Frontier (South of the Abyssinian Border).

The principal tribes inhabiting these practically desert regions bordering on Abyssinia are the Boran, Sakuye, Gubbra and Ajuran. The first three are pagan and have almost identical customs, while the fourth is Moslem. The term Boran may be taken to include Gubbra and Sakuye.

All these tribes are pastoral and nomadic. The district is arid and almost waterless, and residence in any one place is not for a lengthened period, as herds have to be kept on the move to find fresh pastures.

The dwellings consist of small round huts of the beehive pattern, and are built of camel mats made from fibre or grass. The wooden framework or skeleton of the hut is carried on camels when on the move. Villages are as a rule laid out any way, but tend to form a circle and consist of a collection of families. The cattle and camel kraals are on the outside. Each married woman has a hut to herself in which her children live and sleep until their marriage.

No attempt is made at thatching and huts are not rain proof. Beds are raised from the ground, and a kind of bivouac made of hides or camel mats is built over them to ensure privacy and protection from rain. The people have to retire to bed during heavy rains as it is the only dry spot in the hut. The flimsy construction of the dwellings dispenses with the necessity of extra lighting or ventilation. Latrines and ash-bins are unknown and all refuse is thrown into the bush. Very often the old site of a village is fired and the dried dung in the kraals burnt to destroy ticks, bugs, etc.

Cattle and other stock of each village are divided into herds, and people group their huts round their own particular herd. Poultry are not kept.

The chief food is fresh meat and milk, and some drink the blood of cattle mixed with milk. In the dry season the people do not eat much as little milk is obtainable. At such times dom palm nuts are eaten. There are

no fixed hours for meals but the day is begun with a meal of buni. This consists of the coffee bean together with the husk fried in butter into which milk is poured. This mixture is drunk out of small wooden bowls. Meat is usually boiled or stewed. Milk is liberally mixed with water and drunk during the heat of the day. Milk vessels are cleansed by being filled with burning embers of aromatic wood, and great care is exercised. This process

FIG. 13.—Boran Priests.

gives the milk a peculiar but not disagreeable flavour, and it has been observed that milk-borne diseases are almost unknown amongst the people.

Men, women and children may eat together among the Boran but not among the Ajuran.

The Ajuran may eat anything that has been properly slaughtered and which is not forbidden in the Koran. Boran may not eat birds, fish, elephants, zebra, dik-dik, or pig, though they may eat rhinoceros, oryx, buffalo and giraffe.

Intoxicants are practically unknown except among the Abyssinian Boran, of whom some are becoming accustomed to tedj and Abyssinian spirits. Tedj is made of honey and water, allowed to ferment, and mixed with herbs to hasten fermentation. When well made it is an excellent drink and possesses the strength of cider. The spirits are made of maize and barley and flavoured with aniseed. The result is a raw rank spirit which is extremely intoxicating. The manufacture of both drinks is in the hands of the Abyssinians, but fortunately the tribes under review have not become addicted to their use.

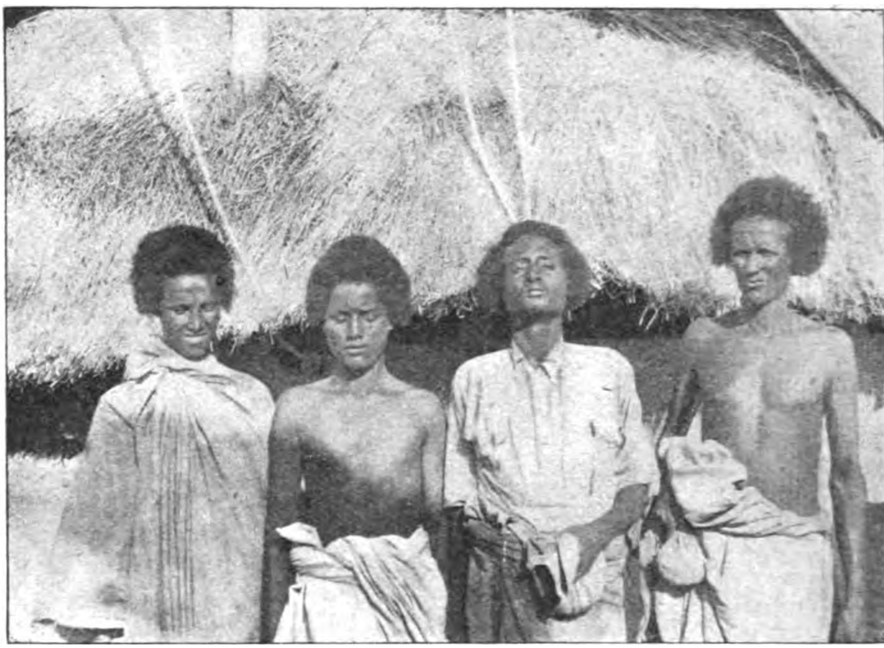


Fig. 14.—Types of Young Men.

The Boran have medicine men but they do not exercise any great influence. Magic and witchcraft, when heard of, are put down as the work of malignant spirits. Medicine men have little or nothing to do with Boran theology, which is very abstruse. Tutelary deities are believed in, also a central god "Wak," who is constantly invoked.

The Ajuran people have no particular class of medicine men and rely largely for cures on the inspired utterances of sheikhs after prolonged study of the Koran.

The Ajuran follow the ordinary Moslem customs as to burial, but their funeral sacrifices are similar to those practised by the Boran.

The Boran bury their adult dead outside the villages in deep graves marked by a large oval mound of stones. The Ajuran make similar

graves but surround them with a strong animal-proof boma. A Boran child who dies before the naming feast has been held is buried in the hut.

The Boran funeral ceremony is very elaborate and the following is an outline of what is done :—

The corpse is wrapped in a new cloth sewn specially for the occasion and carried to the grave by the immediate relatives. After the burial a bullock is killed and eaten by the burial party, excluding the deceased's relatives, and by any members of alien tribes resident in the village. The wife and children of the deceased shave their heads and remove their ornaments, and they, together with the other relatives, keep up a wailing and mourning for many days. Three or four days after burial a bull is killed, and until this sacrifice is eaten none of the relatives of the deceased may exchange greetings with other members of the tribe. Some weeks later, probably after the village has moved elsewhere, a third sacrifice is offered. A pilgrimage is made to the grave and a big feast held. Another bullock is slaughtered and its blood sprinkled on the tomb and all present partake of the meat. All those who participate must depart well before sunset from the grave and spend the night a considerable distance away and any meat which may have remained over must not be destroyed.

These sacrifices vary with the wealth of the deceased and are not so elaborate in the case of poor people. The ceremonies for men and women are practically the same, but the second sacrifice referred to above differs in that a heifer is killed, instead of a bull, in the case of a woman who has not borne a male child.

The Boran are very shy in telling others of their intimate beliefs, and knowledge on this point is still only superficial. They say good people when they die go to a fair land with ample water, countless herds of cattle and flowing with milk and honey. Bad people, they say, go to a dry parched land where there is nothing but sun. They believe the spirits of the departed are constantly revisiting this earth and that malignant spirits are common and often seen. Unless a man is forearmed against the enemy spirits they will await opportunity and kill him. Weapons are useless against these spirits as they cannot die twice. A form of ancestor worship is also performed but accurate details are not easily obtained.

Moslem views of an after-life are generally known, but the most popular belief is of a return to the Garden of Eden, there to associate for-ever with beautiful maidens.

Deformed children when born are not considered human and are at once destroyed. The Boran have also a custom called "raba" in which the first-born immediately after birth is cast out into the bush for hyenas to eat. This custom is not quite general apparently and skips a generation in each family concerned. It originated in a dream of one of their high priests many years ago, and he is said to have been told by God to ordain these sacrifices in order to ensure the fertility of the tribe. Many of the

13

raba victims are rescued and reared by other tribes. Neither the Sakuye, Gubbra, nor of course the Ajuran follow this custom.

It is not possible to estimate birth-rate or infant mortality. It is evident, however, that female births are more numerous than males and that there is a big infant mortality due chiefly to malaria. Anti-conception and abortion methods are known but not practised as children are regarded as a blessing from God. Children are weaned between twelve and eighteen months and where artificial feeding has to be resorted to boiled cow's milk is used. The mother sets about her usual routine duties four or five days after confinement.

There is a legend amongst the Boran which tells how six of their warriors lost their way in the desert and were compelled in consequence to wander for many days in the wilderness living on what game they could kill, and quenching their thirst from waterholes. These waterholes are mere ponds a foot or two deep, are sparsely scattered in the region, and at eventide are the rendezvous of wild animals in quest of water. Eventually these warriors arrived at Uargess, the Sacred Hill, where they came face to face with other warriors and were made prisoners. The Boran did not understand their tongue, and having been bound were driven along at the point of the spear through a defile that led into an underground passage through which they passed into a cave leading out to daylight. On coming out of the cave they found themselves in a large open area surrounded by hills. In the centre there was a deep crater lake with an island in its centre. On this island there was a large dome-shaped building. Small round boats made the journey between the island and the mainland, and by means of these the prisoners were paddled over to the island where they were met by a number of tall bearded men wearing loose garments and who were priests in the temple of the King-Snake. The prisoners were taken to a hut and locked in it. Here they remained for two days and on the third day were taken out and escorted to a building from which emerged a very old woman dressed in a dark robe. She was wrinkled and wizened and had shaggy hair, and with piercing eyes stared at the prisoners. To their amazement she spoke as follows in their own language :—

"Ye men of Boran for what have ye come here? To disturb our peace and customs or as one of ourselves?"

The head Boran warrior stepped forward and said, "Hail, mother. We rejoice to hear our own tongue in a strange land and among people whom we do not understand. We have not come to break your peace or annoy your people. We lost our way in the desert and reached this country almost dead with hunger and thirst and knew not whither we were travelling. We were the 'eyes' sent out in advance to punish a raiding body of Zumals who had stolen our cattle. Now we find ourselves here, but not by our own will, nor do we wish to do hurt."

She spoke : "I speak your tongue and am of your tribe. Many many

moons ago I was taken by the warriors of these people, who are called Ragessi, from a raiding party of Habash who had killed my parents and made me captive. Whether you will die or remain as guests I cannot say. You will be tested and the King will decide."

She beat a drum, and the inhabitants from the villages collected and formed a circle round. One of the priests came forward with a bowl of burning charcoal and placed it on an altar with some aromatic gum which gave off a scented smoke. A couple of black cows were driven in and milked into a calabash.

The old woman said, "Stand forth ye men of Boran and the King-Snake shall judge if ye are his enemies or his friends." Then addressing the people, she said, "Sing ye people the song of the King-Snake so that he may come forth and give judgment."

Bowing to the earth repeatedly and clapping their hands as they did so, the crowd sang the "Song of the Snake." When the song was finished, a gigantic snake appeared and reared itself up, swaying to and fro, and then made a movement towards the six Boran who were standing there.

The old woman and the assembled people knelt down and bowed their heads to the ground as soon as it appeared and sang the last verse of the snake song many times over.

The Boran warriors bravely stood their ground as the snake encircled them, and when it came in front of the head warrior it swayed its head, fixed its eyes on him, and hissed as its poisonous fangs were flickered to and fro. Seeing the warrior did not flinch, it returned to the temple. The prostrate assembly then arose and yelled with delight. The old woman came forward and spoke aloud, "Back, O ye people. These Boran are my people by blood, they have stood the test and our King has accepted them. For ever their people and ours shall be as one. Return to your villages and rejoice. I will take care of my brothers and feed them. Depart now and leave us."

The crowd returned to their villages amid much rejoicing.

The warriors were taken into the temple and on to the verandah. They passed the room in which the King-Snake was. A sacrifice of two goats had been given him and he rested satisfied. When angry they were told that he lashes himself until the building shakes.

After the warriors had eaten their fill the old lady saw them off and bade them farewell, saying "Goodbye, my brothers, ye cannot remain here the night, neither must ye sleep in the valley. Below you will meet some of our warriors who will take you back to the road by which you came here. Go back in peace to your people and mine. Ye shall come again, but I may not be here to greet you. I am old, and may soon go forth to the Fields beyond the Stars. I would rejoice once more to see my native manyatta and hear the cattle bells as the herds return at sunset. Alas, it cannot be. My heart breaks with sorrow at your going. Go quickly and farewell."

The head Boran warrior said, "Mother, we go, and shall think of thee in our hearts. We shall speak of thee to our children, knowing thee to be in the Fields beyond the Stars, where we in our turn may come one day and find thee again ready to greet us, mother. Hail! Farewell."

When after many moons they returned with presents of cattle to the King-Snake and followed by many of their people, she had gone to the Fields beyond the Stars.

THE WA-GOSHA.

The people known by this title inhabit the banks of the river Juba and are the ex-slaves of Arabs and Somalis. They are Central Africans, and are for the most part composed of Wa-Sugua, Wa-Gindu, Wa-Yao, Wa-Nyassa, Galla, Boran, Rindile, Ajuran, Wa-Boni and half-caste Somalis.

Their customs are mainly those of the Somali, the Wa-Sugua retaining their tribal customs and language. Generally speaking, the people are in a degraded state.

The dwellings are composed of huts of the Central African pattern, built of mud and thatched with grass, each family occupying one hut. Villages have no organized arrangement, but consist of a number of families. Latrine and sanitary conditions are absent and the primitive method of resorting to and throwing all refuge into the bush is observed, where fortunately the sun acts as Nature's purifier and cleanser.

The chief foodstuffs eaten are maize, sim-sim, marrows, bananas, cassava, sweet potatoes and rice. The crops are subject to inundations from the river overflowing its banks. A water-lily is eaten during times of famine and scarcity of food.

Food is cooked in native-made earthenware pots. Men, women and children eat together and at any time.

The Wa-Boni, who chiefly live by the results of the chase and are thought to be allied to the Wanderobo (a wandering aboriginal of the interior), consume large quantities of honey beer.

The dietary scale is varied by goat's meat, mud-fish and gill-less fish—the fish being obtained from the river. The fish is also dried as biltong and preserved.

Buni—unhusked coffee berry—stewed in ghee or sim-sim oil with sugar, is largely used by the Wa-Gosha. From the large percentage of caffeine this contains, the practice of partaking it gradually grows into a pernicious habit from which it is difficult to break away.

Livestock are kept in small brushwood enclosures in the villages at night and graze abroad during the day.

Disease is regarded as the will of God, the Wa-Gosha being Mohammedan in religion. Malaria and syphilis are very prevalent, the significance of the latter being understood and regarded with fatalism, and

as a link with the conditions of previous Arab slavery. Domestic native-prepared medicines in some cases are used by the tribes, but Somali remedies are usually adopted.

The dead are buried in shallow graves without distinction of rank, and with the usual Islamic ceremonies. The views of a future life are the same as the Somalis, and are those of a crude Mohammedanism.

The average length of life is about 40 years, but many live to over 60 years.

No birth or infant death-rate figures can be given. Small families are the rule and, as in the case of the Somalis, children are appreciated.

The conjugal relations of the Wa-Gosha are extremely loose, which is possibly due to the fact that the "meher" for a non-virgin is only seven rupees in the greater part of the district.

The friendship between husbands allows the use of each other's wives.

Blood brotherhood amongst certain pagan tribes prevails. This relationship is effected by the blood from a slight wound in the arm of one being exchanged and rubbed into a similar wound in the arm of another. The significance is a lasting friendship for all time.

Jubaland Somalis.

The Somalis are a nomadic race, and as a rule have no permanent villages, with the exception of a small number on the Coast, such as at Kismayu or Gobwen, whilst in the interior a Somali village is permanently established at Nairobi.

On account of grazing grounds required for cattle, the Somalis have to be continually on the move, and as a result have to dismantle and pack up their huts and belongings on bullocks and camels on the occasion of each move.

The huts are of haystack form and made of grass mats dressed on long sticks stuck in the ground. The dwellings are substantially erected, and can withstand heavy rains and gales. The huts vary in size according to the wealth of the occupant, and are not lighted or ventilated, as the Somali dislikes anything in the nature of a draught. A village may consist of any number of huts from ten to a hundred, and is surrounded, as a rule, by a zareba or thorn fence, this latter intended to protect themselves and their cattle from the dangers of the jungle. Members of a family occupy the same hut, and the live stock are housed in the centre of the village.

The Somali being chiefly a stock breeder does not cultivate the soil; meat, milk and ghee constitute his chief articles of food. When he travels to the Coast he sells or exchanges hides and skins for cloth, rice and maize, which are taken back to the interior.

Men, women and children eat together, but in the event of friends being invited by the husband to a meal, the women and children have to wait for their portion until the host and his guests have finished.

Animals have to be killed in the lawful way, according to Mohammedan rites, and pork is strictly forbidden, as are also intoxicating drinks.

Tea is used by the well-to-do. Coffee beans baked in ghee or sim-sim oil is a very much relished dish for breakfast. Camel meat is salted, dried in strips, and taken on the march to be eaten. A preparation is made from camel's milk by mixing it with powdered black pepper, garlic, saffron, and coriander. This is put in a vessel and kept for a couple of months before being partaken of. Dried raw shark is also eaten.

FIG. 15.

Medicine men have, as a rule, very little influence amongst the Somalis, but the sheikh is feared. There are few domestic remedies for illness, but sim-sim oil is boiled and afterwards used for any injury or disease by being well rubbed into the affected part. The chief remedy in illness is, however, to read a part of the sacred Koran, or to write in ink a few verses on a plate; the plate is washed with a little water, and the liquid given to the sick person to drink.

The Somalis, being professed Mussulmans, regard sickness as the will of God, and take very little precaution against it.

The dead are all buried with the usual Mohammedan rites and ceremonies. The body is washed, dressed in a white cloth, and carried on a native bed by bearers to the place of interment, followed by members of the tribe.

The views of a future life are those of crude Mohammedanism. They believe in the existence of heaven and hell as places for the good and bad after death, the souls of the latter reverting to the former after expiation for sin. The dead are supposed to influence the welfare of the living by their prayers in heaven.

The Somali trades largely in cattle, mules and donkeys, and travels widely in the interior, covering immense distances on foot or mule; a march often takes months before he gets to his destination.

He is keen and intelligent, of good average height and build, with a handsome type of countenance.

The birth-rate is estimated between 100 and 150 per cent of the married population, and infant mortality, mostly due to malaria, is heavy under the first three years. The average woman generally gives birth to about five children in her life, and in a few instances to as many as ten. No measures to prevent birth are adopted, and children are regarded as a blessing. The child is not weaned till twelve or eighteen months old, and when the mother's milk is insufficient, boiled cow's milk is used as a substitute.

VENEREAL DISEASES UNDER ARMY ADMINISTRATION.[1]

By Major A. T. FROST.
Royal Army Medical Corps.

Every three months there is read on parade to every unit of the Army a paragraph of King's Regulations which states that under pain of punishment it is the duty of any man who contracts venereal disease or who suspects that he may have contracted such disease to report sick at once. The Army system of notification of venereal disease is thus legalized and medical action taken as the result of it.

The soldier is told to report sick as soon as he notices an abrasion of his genitals; every effort is made to examine, diagnose and treat syphilis before it has advanced sufficiently to give a positive Wassermann reaction. The treatment is begun within a few hours of diagnosis, at the latest. He is given a weekly injection of one of the arsenobenzol preparations, or, what is now used more commonly, one of the novarsenobenzol preparations—using the words arsenobenzol and novarsenobenzol as group names for any of the "606" or "914" substitutes. In addition, a weekly injection of mercurial cream is given.

Early cases, negative to the Wassermann test, are given seven arsenical injections at weekly intervals with an extra week's rest after the third and fifth injections. After the seventh injection six weeks' rest is followed by two more injections to complete the course. Also eight injections of mercurial cream are given at weekly intervals, during the first eight weeks. It is believed that to ensure the largest percentage of complete cures the injections should be increased to ten of each drug, or even more. The dosage of arsenical drugs is small in the Army compared with many of the civil clinics, varying between 0·3 and 0·4 gramme of arsenobenzol and equivalent doses of novarsenobenzol. In treating syphilis in the advanced primary or secondary stages the minimum amount of treatment is three courses consisting of twenty-one injections in 380 days. Most cases require a more extensive course and probably thirty injections give more successes. At the end of these courses the man's further treatment depends on the result of blood and cerebrospinal fluid tests.

In the Army, however, we are much more concerned with early cases, with the men we can cure quickly, and who may become efficient with only a comparatively short period under medical supervision. Cases of syphilis are treated as in-patients until no open active lesions are present: in early cases about fourteen days in hospital will suffice, as experience has shown it is then perfectly safe to allow men to return to their barrack room.

Whether a case of syphilis is treated at his own station, or transferred

[1] Read at the Scarborough Congress of the Royal Institute of Public Health, 1923.

to another to complete his treatment, there is rarely any delay in its continuation. If a unit is sent to a foreign station the men suffering from syphilis are treated on board ship, and the commanding officer of the unit is responsible that their medical documents are handed over to the medical officer who will take over the further treatment of the case. Notification within the unit is not confidential: it is almost on the same footing as measles or smallpox, except that the medical documents on which the case is recorded are treated as confidential.

In the Army gonorrhœa is treated in hospital from the date the man reports sick until he is certified as cured. We ought to be able to abort gonorrhœa in the Army, if it were possible, but in recent years it has become so painless that the disease has reached the stage of a profuse yellow urethral discharge before the man recognizes he is infected and reports sick. The disease has then gone beyond the abortable period.

In our treatment of gonorrhœa we have had as little success as the rest of the medical profession. So far as drugs are concerned, no advançe has been made in the last sixty years, since the introduction of potassium permanganate, and the reason is because we have not yet got the correct line of attack on the disease.

As the result of experiments at the Military Hospital, Rochester Row, posterior irrigation has become the Army method. It is considered to be mechanically better than anterior irrigation even when the posterior urethra is unaffected. But the best results are poor, and only render the urethra a somewhat unfavourable nidus for the growth of the gonococcus until such time as the man's resistance terminates the disease.

Anti-gonococcal vaccines are considered to assist in the prevention of generalized infection; but are of no use against the urethral infection. The average case of gonorrhœa in the Army requires treatment for some six weeks by irrigation with potassium permanganate, varied occasionally with a silver salt or oxycyanide of mercury for secondary infection, and in the later stages by the use of sounds and by prostatic massage before the test for cure is carried out. The test for cure is either the injection into the urethra of various irrigating substances, such as nitrate of silver, or a one in five hundred solution of chloride of magnesium injected twice a day for two days, or the injection into the urethra of a dose of vaccine containing one hundred millions of dead gonococci; also the introduction of sounds and dilators, the examination of the contents of the prostatic glands, and a minute inspection of the urethra by means of the urethroscope. Three or four days are required to complete the test, which is followed by a further period of treatment and, in any case of doubt, another test for cure.

Soldiers must be treated in hospital when suffering from gonorrhœa. The objection to treating gonorrhœa outside hospital would be valid only in time of peace—I shall refer to the subject under war conditions, when use might be made of men suffering from this disease. In the Army gonorrhœa

is a much more serious problem than syphilis because the incidence of the former is three times greater than that of the latter disease; moreover, the gonorrhœa cases must be kept in hospital more than twice as long as the syphilis cases—a wastage of men at least six times greater from gonorrhœa than from syphilis. An attack on the disease from an altogether different standpoint must be begun before any advance can be expected in reducing the time under treatment. The organism of gonorrhœa is protected from the action of antiseptics introduced into the urethra by living under layers of epithelium through which antiseptics cannot penetrate without injuring the cells. The attack must be made through the blood, and possibly the drug which will be successful is one of the dyes formed with the benzene ring as a nucleus. Recent work on some of the dye stuffs encourages the hope that one or other of them may have a selective action on the gonococcus.

Great as is the desire of the Army to cut down the wastage due to venereal diseases in peace time, it becomes a more important duty in war time. The system employed during the late war in dealing with these diseases differed only in detail from that of peace time. It is to be regretted that such a unit as an equipped venereal section of a general hospital did not exist in the original Expeditionary Force: such a unit would have simplified the work of treating venereal diseases in the early days of the war, and it is hoped that it may be available for any future expeditionary force which leaves this country.

The concentration in one large hospital of large numbers of men suffering from venereal disease is not the best method of dealing with these cases in war time, unless we can remove the moral stigma which exists against them in the public mind. As venereal diseases are not infectious in the ordinary sense, there is no reason why a section of a general hospital should not deal with the cases from its own area. Discipline and the temper of the men would then be better, for no diseases are so liable to affect the mental condition of the sufferers, and while under treatment they should be made as cheerful as sufferers from other diseases.

As a war method of treatment the use of the "606" group had to give way to the "914" group for two reasons. One, because the "914" was easier and quicker to administer, and it was found that the results of injecting the "914" subcutaneously were better than those of "606" given intravenously. In France, during the war, many thousands of cases were treated with subcutaneous injections of "914" dissolved in fifteen minims of distilled water. Of these the first two or three were given in hospital, the remaining three or four while the men were in convalescent camps, undergoing a system of drills and exercises to keep them fit. Thus large numbers of men were kept away from their units, and were practically non-effective, although fit for a full day's work. It is to be hoped that in the future such men will be returned to their units much sooner, and the remainder of their treatment be carried out by the medical officer in charge of

the unit. To do this without loss of efficiency in treatment certain conditions must be satisfied. First the arsenical preparation must be made up ready for use in phials which should keep indefinitely without deterioration or increase in toxicity; secondly, the drug must have a high curative and a low toxic figure; thirdly, the volume of fluid must be small and capable of being injected under the skin without discomfort to the patient. So far such a drug has not been put on the market by any firm. There are, however, two preparations each of which possesses some of the above requisite properties. One is the base of "606" joined to glucose and dissolved in a glucose solution which is ready for use in the phial in which it is stored. It is of high curative value and of low toxicity, but it is not without pain when injected into the deep tissues. The second is a sulphur preparation of "606," also of low toxicity and high curative value, which can be injected under the skin dissolved in ten minims of water, but it is not ready for use in the phial. To eliminate the painful quality of the one, or to make the other into a preparation ready for use in solution, ought not to be an insuperable difficulty. Given such a drug the only other requirement for treatment in the field would be a hypodermic syringe and some methylated spirit to sterilize it.

A simplified case card requiring the minimum of writing would facilitate the keeping of records. It might also be considered whether it would not be possible to give the patient a copy of his treatment card to obviate delay in carrying out his injections if rapid movement from place to place or change from one unit to another should occur. Some cases might be missed, but the system of treatment in the field would mean many units returned to full duty in the numbers thus saved. The success of such a scheme would depend on clear and precise directions worked out and taught beforehand. If the system should prove practical in peace time experiments, no variation from a definite scheme of treatment laid down would be permissible, except in the case of arsenical intolerance.

Bismuth must be taken into consideration as an anti-syphilitic in the near future. Mercury is in danger of losing its position in the treatment of syphilis since the metal bismuth and its salts have been proved to be of higher value. It is easier to give than intramuscular injections of mercurial cream as each dose is prepared in a phial ready for use and is not influenced by either keeping or climate. Time may prove, if a suitable arsenical drug is not produced, that bismuth treatment in the field would be the simplest and best military method of treatment of syphilis.

Whether cases could be followed up in war time, after the completion of their treatment, would depend on the administrative measures made for the examination of blood and cerebrospinal fluid. A patient must have some months' rest after the completion of the treatment, and at some favourable opportunity a sample of blood for the Wassermann might be taken at the nearest field ambulance or general hospital or other medical unit, without interfering with military duties. Cerebrospinal fluid could

be taken by one of the surgical staff, and both blood and cerebrospinal fluid, packed in the special Army box for the purpose, forwarded to the nearest laboratory which is notified as equipped for carrying out the necessary examinations. In the case of lumbar puncture twenty-four hours' rest would be necessary. Under certain conditions a ten days' rest might be essential owing to intolerable headache; but this is not common, and may be avoided by using the finest possible needle and making only one puncture in the canal coverings, by keeping the patient in the knee chest position for an hour afterwards and lying on his face for the rest of the day. The headache is due to slow oozing of cerebrospinal fluid from the wound made by the needle in an elastic membrane which is kept open by its elasticity. Lying on the face for some hours allows the closure of the puncture with lymph and prevents further oozing.

Further treatment would be governed, as in peace, by the laboratory report, and the unit system of dealing with any relapses would keep the man out of hospital.

In the next big war medical officers are likely to have much more practical experience in the treatment of venereal diseases than they had in the late war owing to the civil venereal clinics, and also because by that time the subject will be taught by the medical schools in a more special manner than at present.

The attitude of the Army towards the prevention of venereal diseases has caused it to be accused of condoning sexual irregularity. There is no truth in such a charge. The Army inculcates that continence is a duty and a high ideal for the soldier. Any other attitude would not be tolerated by the State.

The military authorities realize that the soldier runs much risk of contracting venereal diseases, and they have decided that he shall be given opportunities of using means to prevent himself becoming infected if he wishes to make use of them.

The Army, therefore, provides disinfectants for those who will not remain continent: and whilst impressing upon the men that continence is the only safe method of avoiding disease, yet—if they will foolishly expose themselves—they are recommended to use the disinfectants and take all precautions to prevent infection, for it is their paramount duty to keep fit.

The prophylactic packet at present in use in the Army contains a tube of Metchnikoff's calomel cream to which is added oxycyanide of mercury in a strength of 1 in 1,000, also a swab of cotton wool enclosing a piece of soft soap, all enclosed in an envelope with directions for use printed on the front. The directions advise the use of the preparations as soon as possible after risk of infection has been incurred and lay down a time limit of three hours, after which the man is advised to consult his medical officer as to what he ought to do.

Practically the only time that successful prevention may be hoped for

is within the first three hours after risk, and it would be better if men were taught that they are not safe if they postpone treatment beyond the first hour. The Army is committed to self-disinfection, and therefore the method should be made as simple and easy as possible compatible with efficacy.

Calomel is still the best anti-syphilitic in spite of some recent criticisms. Potassium permanganate is not reliable in preventing gonorrhœa when issued in small quantities, as it is quickly oxidized when exposed to air and still more rapidly destroyed when exposed on a large surface when absorbed by cotton wool. It is also destroyed by contact with organic material on the genitals such as mucus and epithelium, and its action ceases as soon as it dries after application. We have no trustworthy data from which deductions could be drawn as to the value of the drugs used in the prevention of venereal diseases, but there is one significant fact from which an inference might be drawn, that is, the widening difference between the incidence of syphilis and gonorrhœa in the Army compared with the same diseases in civil life, where the ratio has not changed. At the present day the ratio in the Army is one of syphilis to four of gonorrhœa, and they are in about equal numbers in civil life. This reduction in syphilis coincides with a campaign of prevention during the last few years, without a corresponding lowering of the numbers infected with gonorrhœa.

The French Army have been experimenting with a one-tube packet which contains cyanide of mercury 0·75 per cent, calomel 25 per cent, and thymol 1·75 per cent in 50 per cent lanoline, and 23 per cent soft paraffin put up in keratin capsules. Soap is also supplied. The action of this cream is bactericidal against the *Spironema pallidum*, the *gonococcus* and the organism or organisms of soft chancre. The Navy are testing chinosol added to the calomel cream in a one-tube packet. The final selection of a prophylactic should be such that men are not discouraged from using it by seeing their companions who have used it unsuccessfully, sent to hospital; the preventive packet must not be a broken reed to the incontinent.

It is an accepted fact that the incidence of venereal disease is in proportion to the amount of risk incurred apart from whatever measures of prevention are put at the soldier's disposal, which brings us back to the only sure method of preventing venereal disease—continence. On this the Army has concentrated by social methods, and it is only as a help to lessen disease that medical prophylaxis is made use of; it is not the main weapon against venereal diseases.

Clinical and other Notes.

REPORT ON THE EFFICIENCY OF THE TREATMENT OF BILHARZIOSIS BY INTRAVENOUS INJECTIONS OF ANTIMONY TARTRATE, AFTER TWO YEARS.

By Captain R. N. PHEASE.
Royal Army Medical Corps.

As two cases of active bilharziosis were admitted to hospital early in 1923 and were known to have been treated previously with tartar emetic, which has been regarded as a permanent cure for the condition, it was considered advisable to make a complete examination of all cases within reach who had suffered from and been treated for the disease.

The following is a brief summary of the history of the outbreak:—

In May, 1921, the 2nd Battalion Royal Ulster Rifles was drafted to Egypt from Mesopotamia where they had been heavily infected with bilharziosis. On the arrival of the battalion in Egypt from Mesopotamia a complete examination was made of all suspects, with the result that forty-four cases were found with active symptoms of the disease. Between the date of their arrival and December, 1921, fifty-seven more cases developed and brought the total number of cases treated in the Citadel Military Hospital, Cairo, for the year 1921 up to 101.

In 1922, twenty-three cases of bilharziosis were admitted from the Royal Ulster Rifles. Of these thirteen were admitted for the first time and ten were relapses. All these cases undoubtedly contracted the disease in Mesopotamia, and the delay in the manifestations of the symptoms may be accounted for by the great variability in the incubation period of the disease.

Treatment.

All cases were treated with: (1) Intravenous injections of tartar emetic; (2) urotropin ten grains t.d.s.

The tartar emetic was given in ten cubic centimetres of normal saline in gradually increasing doses as follows:—

1st	0·5 grain
4th	0·5 ,,
7th	1·0 ,,
10th	1·0 ,,
13th	1·5 grains
16th	1·5 ,,
23rd	2·0 ,,
30th	2·0 ,,

The interval allowed to elapse between the administration of the injections is considerably longer than is usual, the reason for this being that it was desired to run no risk of unpleasant after-effects that might cause

the treatment to become unpopular with the men, and so lead to concealment of the disease.

AFTER-EFFECTS.

(*a*) *Immediate.*—As a rule no untoward after-effects were experienced by the patient. Occasionally a feeling of choking and suffocation was complained of, and in some cases slight rigors and slight rises of temperature developed after the injection. Attacks of vomiting and headache also occurred in a few cases.

(*b*) *Remote.*—Two cases developed jaundice in the course of this treatment, probably due to a special idiosyncrasy to the drug. In both cases the jaundice developed during the later stages of the treatment when the larger doses were being administered, and on the injections being withheld the condition quickly cleared up under appropriate treatment.

RESULTS OF TREATMENT.

The results of treatment of bilharziosis by tartar emetic must be considered under two headings: (1) The immediate effect on the disease in its acute form.

(2) The remote effects, with regard to its efficiency as a complete cure of the condition.

(1) *Immediate Results.*—Under the influence of antimony tartrate the live ova rapidly disappeared from the urine. Degenerated ova, characterized by their granular appearance, persisted for some time, reappearing at intervals while pus cells and red blood corpuscles persisted for still longer periods.

The average number of days under treatment amounted to approximately forty-four. The average amount of tartar emetic administered amounted to 10·9 grains. No patient was discharged from hospital as cured until the urine was completely free from blood, pus and ova on three examinations at two days' interval, and until all signs of cystitis had disappeared.

The immediate action of antimony tartrate on bilharziosis was therefore very satisfactory. All cases showed a progressive improvement from the beginning of the treatment, and on discharge from hospital they were apparently cured.

(2) *Remote Effects.*—As a result of the occurrence of two cases of bilharzia in January, 1923, which had shown a recrudescence of active symptoms a year after cessation of treatment, it was decided, in order to test the efficacy of the treatment to examine all cases remaining with the battalion who had already undergone a course of treatment with tartar emetic and had been discharged as cured. In the interval unfortunately a large proportion of the cases treated had returned to the United Kingdom as time-expired, so that only a small proportion was available for re-examination.

Only cases infected with live ova were diagnosed as positive, and when any doubt existed the miracidium was allowed to hatch out before a positive finding was given.

The following table records the results of the examination :—

Total number examined	Positive	Negative	Doubtful
35	7 ..	27 ..	1
Percentage	20·0 ..	79·5 ..	0·5

The case marked doubtful showed large quantities of blood and pus in his urine; but repeated examinations failed to reveal the presence of ova. He has been admitted to hospital for further examination.

The following is a brief summary of the medical history with regard to bilharziosis of the positive cases :—

(1) Rifleman A. First admission June 11, 1921, to August 8, 1921 (fifty-nine days); 10·5 grains of antimony tartrate received: no symptoms on discharge. Second admission February 2, 1922, to March 21, 1922 (forty-eight days); 10 grains of antimony tartrate given intravenously; no symptoms on discharge.

(2) Bugler B. First admission May 29, 1921, to August 22, 1921 (eighty-eight days); 13 grains tartar emetic received; no symptoms on discharge. Second admission February 2, 1922, to April 4, 1922 (sixty-two days); 10 grains tartar emetic received; no symptoms on discharge.

(3) Serjt. C. Under treatment in Citadel Military Hospital, Cairo, from January 3, 1922, to March 13, 1922; 12·5 grains of tartar emetic received. On discharge the urine was free from blood, pus and ova.

(4) Rifleman D. Under treatment from February 22, 1922, to May 4, 1922 (forty-four days); 10 grains antimony tartrate received; no symptoms on discharge.

(5) Rifleman E. Under treatment from June 11, 1921, to August 8, 1921 (fifty-nine days); 9 grains of antimony tartrate received; no symptoms on discharge.

(6) Rifleman F. Under treatment from March 15, 1922, to May 4, 1922 (fifty-seven days); 10 grains of antimony tartrate given; no symptoms on discharge.

(7) Rifleman G. Under treatment from October 10, 1921, to November 16, 1921 (thirty-eight days); 8·5 grains tartar emetic received; no symptoms on discharge.

(8) Doubtful Case. Rifleman H. Under treatment from February 2, 1922, to April 4, 1922 (sixty-two days); 10 grains of tartar emetic received; no symptoms on discharge.

Of the seven positive cases, Nos. 1 and 2 have relapsed for the third time.

Conclusions.

(1) That the immediate effects of the treatment of bilharziosis by tartar emetic are eminently satisfactory, removing all traces of the disease from the patient in a comparatively short time, but the cure in twenty per cent of cases is not permanent.

(2) That all cases of bilharziosis should be kept under observation for at least two years after discharge from hospital, and that periodical examinations should be carried out in order to detect any recurrence of the disease.

NOTE ON STANDARD PATTERN X-RAY COUCH BY BUTT.

By Major W. W. BOYCE.
Royal Army Medical Corps.

The accompanying drawings illustrate an improvement to the over-the-table tube holder supplied with the standard pattern X-ray couch by Butt.

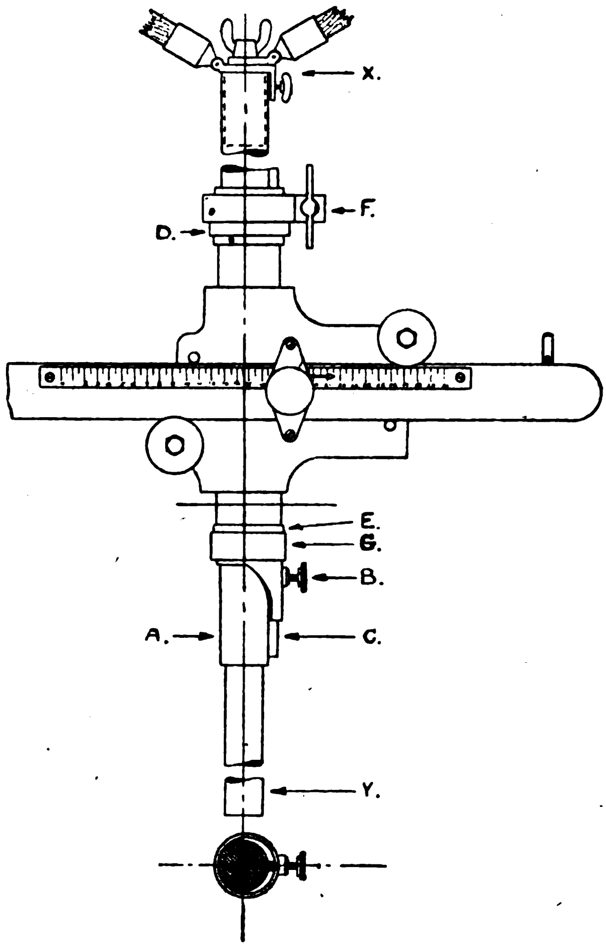


Fig. 1.

This table is a satisfactory one to work with except that there is no means of raising or lowering the tube holder except by hand lift.

As the weight to be raised or lowered is thirty-five pounds fine adjustments of distance cannot be made comfortably, one hand only being available for the lift whilst the other manipulates the set-screw (shown at B in fig. 1).

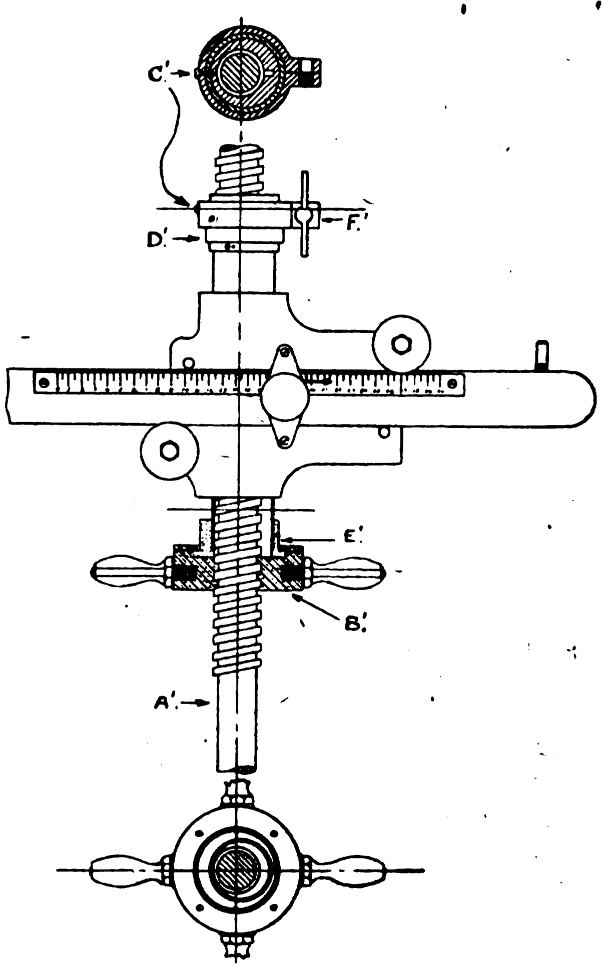


Fig. 2.

Further, any failure to tighten sufficiently this set-screw—which works on a feather—may result in the tube-box falling, with consequent shock to the patient and damage to the X-ray bulb.

To obviate this the possibility of counterpoise and lift by rack and pinion was considered, but, for various reasons were found impracticable.

The screwed-shaft and brass nut illustrated in fig. 2 is, however, in every way satisfactory and is quite foolproof.

The design is due to Lieutenant W. Benn, M.B.E., R.E., and the

work was carried out under his supervision in the R.E. Workshops. Malta, of which he is in charge.

APPARATUS.

Functioning of Relative Parts.

	Standard pattern.		Improved pattern.
A	Plain shaft throughout.	*A*¹	Screwed shaft, but top and bottom as original. See *X* and *Y*.
B	Set screw to support lamp and bracket, after making vertical adjustment, during which the cantelevered weight of thirty-five pounds is supported by hand.	*B*¹	Brass nut with four ebonite handles, taking weight before, during, and after adjustment.
C	Longitudinal key to locate eccentric sheaves *D* and *E*.	*C*¹	Additional cheese-head screw locating clip *F*¹ to original sheave.
D and *E*	Eccentric sheaves.	*D*¹	Is the original sheave *D* with screw *C*¹ added.
		*E*¹	New designed flanged eccentric sheave, with three screws in place of *E*, *B*, and *G*.
F	Top clip.	*F*¹	Original top clip.
G	Bottom clip.		Not embodied in new design.

NOTE.—This pattern of Field Service X-ray couch is obsolete and is not now issued; but there are probably many of them in use abroad and, as it may be some time before the new pattern is distributed overseas, it is considered this note may be of use.—EDITOR.

THE END OF WOODEN LEGS.

BY CAPTAIN H. H. C. BAIRD, D.SO.
Late The Buffs.

CAPTAIN H. H. C. BAIRD, D.S.O., late The Buffs, the Editor of *The Dragon*, a paper for the men of the Buffs and the men of Kent, in sending us the following interesting account of the New Desoutter duralumin artificial leg, writes: "That experience has definitely proved that it is the exception rather than the rule for ex-Service men to know the condition under which metal limbs are now being supplied, and I am anxious to help them, and I thought a good way in doing this would be to obtain publication of the story of the limb, etc., in regimental newspapers, many of whose readers are in touch with those who have suffered leg amputations."

London to Brighton in fourteen hours twenty-one minutes with an above knee amputation. Such was the astounding record made a few months ago by Mr. Victor Bell, wearing a New Desoutter duralumin artificial leg and

breaking his previous record on another type of leg by no less than four hours thirty minutes. And yet, the great majority of those who have lost a leg in the service of their country are still quite unnecessarily being dragged down by the burden of wearing a heavy and often ill-fitting wooden leg of an obsolete pattern.

That this statement is true is proved by the fact that, whereas some 30,000 officers and men suffered leg amputations as a result of the late war, only some 3,500 duralumin artificial legs have been supplied up to date, and this in spite of the recommendations of the Williamson Committee on artificial legs, which I shall deal with later, and in spite of provision having now been made for the immediate supply of the New Desoutter leg to the many thousands now entitled to them.

The plain fact is that the great majority of legless ex-Service men are either still unaware of the conditions under which this wonderful duralumin leg can now be supplied, or else believe that their issue is still confined to officers, all of which explains why one, like myself, who has derived all the benefits of this wonderful leg should seek the co-operation of Regimental Papers and Old Comrades Associations, both of which are no doubt in touch with many of their old comrades to whom this article particularly applies.

The First Light Metal Leg.

It is now nearly ten years since the first light metal limb was made by the brothers Desoutter—one of whom had lost a leg while flying at Hendon. Amazed at the primitive appliance supplied by limb-makers—there has been scarcely any improvement in wooden artificial legs since the Battle of Waterloo—they set to work, both being practical engineers and experts in aluminium alloys, to experiment with light metals in relation to artificial limbs. The result of these experiments, achieved after infinite labour and many set-backs, is known to the world to-day as the "Desoutter" type Light Metal Leg and Double Swivel Pelvic Band. This limb has been now adopted by the Ministry of Pensions.

The wonderful success of the duralumin limb gradually became public property, and a steady flow of officers began to investigate the truth of the amazing stories that reached them. To these officers the enormous advantages of this limb were obvious, and those who could afford the cost gladly paid as much as £100 or more, out of their own pockets, for a duralumin limb, leaving behind an ever-growing pile of discarded heavy wooden legs.

Redemption of Country's Promise.

Very soon these officers, in their natural desire for the well-being of their less fortunate comrades, began to agitate for the redemption of the country's promise to the limbless, and insisted that the duralumin light limb should be supplied to *all* ranks irrespective of its cost, and that the cumbersome and heavy wooden leg should be scrapped. Official opposition

was chiefly on the ground of the great expense involved, and, for a time, humanitarian arguments were unavailing. The position was admirably summed up by Mr. John Galsworthy, the great author, who wrote in a foreword to the Disabled Society's "Handbook for the Limbless."

"The evidence collected here in its favour, and against the heavy wooden limb, is most striking and exhilarating. The only real argument now against the light leg would seem to be expense. If that is so, one can only urge that every effort be made, officially and otherwise, to overcome that difficulty. We may be bankrupt, but not so bankrupt as all that, where a great boon to the limbless is concerned."

Space will not permit of telling the full story of how the Red Cross, the Press, the Disabled Society, and disabled men themselves ultimately obtained complete victory. It is sufficient to say that the evidence to which Mr. Galworthy refers was ultimately brought before Mr. Ian MacPherson, K.C., Minister of Pensions, who set up a special Committee of Enquiry of a most representative character to investigate it. The result was a triumphant vindication of the case for the Desoutter type duralumin limb, as is proved by the fact that the Ministry of Pensions, who up to this time had been averse to recognizing the wonderful merits of light metal limbs, immediately adopted the recommendations put forward by this Committee.

Supply Becomes General.

These recommendations were that the New Desoutter duralumin leg could be supplied in the following circumstances:—

(*a*) New cases of amputation above the knee, especially those in which the amputation is higher than midway between the knee and the hip joint.

(*b*) Other cases of above knee amputation where, owing to the weight or type of the artificial leg in the man's possession, he is handicapped in his activities or occupation.

(*c*) Cases in which a metal limb is not certified to be surgically necessary, but where the pensioner, owing to his mentality, may conceive a preference for a metal limb, and might consider it a grievance if it is not supplied.

(*d*) For below knee amputations where the surgical aspect of the case renders a wooden limb unsuitable.

Now, from the above, it will be noticed that the supply of the duralumin leg has been made almost general, and it will no doubt interest legless men to know that another concession that I have recently been able to obtain from the Ministry of Pensions is that applicants for this type of limb shall have the right of appearing before the limb fitting surgeon of their respective areas.

So nothing remains but to make it known that limb fitting centres have now been established throughout the British Isles, that other ranks dissatisfied with their present artificial legs should make application for the duralumin type through their local War Pensions Committee, and that officers should do likewise direct to the Ministry of Pensions.

THE LEG AND ITS ACHIEVEMENTS.

No one need fear disappointment. My own amputation is a short stump through the thigh, yet 36 holes of golf in one day over St. George's, Sandwich—an arduous up-and-down course—is nothing to me. And yet I feel thoroughly ashamed at mentioning these modest achievements when we hear of Mr. Bell's astounding walk from London to Brighton, of Mr. Desoutter with an above knee amputation manipulating with his artificial leg the controls of his aeroplane, of Mr. Herbert Marshall, also with an above knee amputation, playing the lead in the theatres of London, and a whole host of others achieving quite as much, if indeed not more, with the utmost freedom and ease.

Surely there can be no greater vindication of what I have written, and I would ask all who may read this article, to pass the news it contains on to any legless man they may happen to encounter. Also, needless to say, should anyone wish for further information I shall be happy to supply it to them if they will write to me at Bridge, near Canterbury.

[Readers of our Journal, seeing that the author is not a medical man, will be interested to know how the problem of artificial legs appears to the layman.—EDITOR].

Travel.

FLOTSAM AND JETSAM.

BY COLONEL S. F. CLARK.
Army Medical Service (R.P.)

I.

EVERY man who has spent the whole of his active life in the Army has had experiences which can bear telling, and I fancy that one or two of the things that I have seen or done were out of the common, and are worth describing. The most unusual adventure of my service was my presence at the seizure of Kowloon City, for I doubt if any other surviving officer of our Corps has been actually present at an interview between opposing authorities, at which the immediate giving up of a town to superior force was demanded from a nation with which we were not at war.

Everybody who has been to the Far East knows that Hong Kong itself is an island, separated from the mainland of China by that portion of the sea that forms the harbour, and that since 1860 we have also possessed a slice of the mainland opposite, which is known as Kowloon, and which is incorporated with the rest of the Colony. A rifle can send its bullet across the harbour, so some years ago the British Government entered into negotiations with China to have the boundary line of Kowloon placed

further back, for the better protection of Hong Kong from possible hostile gun fire from land or water that did not belong to us.

What *quid* was offered for the *quo* I know not, but in 1898 the Chinese Government agreed to hand over to England a large piece of the Kowloon Hinterland—known now as the New Territory—but the walled city of Kowloon, which is in this area, was not included in the agreement. This meant that a Chinese city, belonging to China, was left as an excrescence on British ground, and the decision was not received well by the Europeans in Hong Kong.

The local peasantry, however, did not like the idea of being handed over, willy-nilly, to foreign devils, and with great pluck they rose against us. The hoisting of the "Union Jack" and the annexation of the New Territory were to have been done with much ceremony in the presence of the beauty and fashion of the Colony; but this unseemly attitude of our new subjects upset the programme, which was expedited and carried through by a small armed party. Flying columns from the garrison then put down the rising in a few days.

As a punishment for this disaffection against a diplomatic agreement, it was decided to straighten out the Kowloon City tangle by seizing that town and adding it to the Empire. The scheme was kept very secret, and just after lunch on May 16, 1899, I was ordered to proceed forthwith to the military wharf, equipped for service. I there learned that the local Volunteers had been hastily mobilized, and, with a company of the Welsh Fusiliers, were to embark in launches for Kowloon City—four miles away on the opposite shore as the crow flies, but a little farther by sea.

The force was commanded by the Colonel of the Fusiliers, and the medical aid was myself and four R.A.M.C. men. The Volunteers had their own M.O.—Lowson, one of the few survivors of the Hong Kong Cricket Team that was lost in the "Bokhara," on their way back from playing in Shanghai, a few years before.

We steamed across the harbour wondering if we were going to have any "fun" or not, but there was no sign of opposition. The Chinese garrison had got into mufti, and mingled with the inhabitants, who turned out in force as sight-seers. The troops landed at a wharf and made for the walled enclosure through the outlying suburbs. The regulars disembarked first, and my party went with them. We brought up the rear, and as the doorways in the narrow streets were crowded with Chinese, and as I was absolutely the last man in the little column—for I thought it was up to me, under the circumstances, to follow my men—I did not feel too comfortable in regard to the ease with which a sudden stab could be done.

Inside the walls was the mandarin's yamen, quite a large building, with courtyards inside it, and our C.O. invited me to accompany him and the political officer—afterwards Sir Henry May, K.C.M.G., Governor of Hong Kong, who died lately—to the pow-wow with the mandarin. He collected an R.E. officer, who was also unemployed, and the four of us, with an

interpreter, entered the yamen and went well inside it into a small room, where we were soon joined by the mandarin and two or three of his staff. He was intensely nervous, and when the surrender of the city was demanded, he said that he could do nothing without the sanction of his superior, the Viceroy of Canton. That was his answer to everything, but when an officer came to the door and reported that the rest of the troops were arriving, the C.O. took out his watch and said to the interpreter, "Tell him (the mandarin) that from this moment, ten minutes past three, on May 16, 1899, this town belongs to Queen Victoria of England."

The mandarin said that he could only yield to the force brought against him, and asked for a certificate that he had capitulated to troops that he was unable to resist. This was for his protection from the wrath of the Canton Viceroy, but whether his head came off afterwards or not we never knew. Certainly he and his men had not put up even a pretence of a fight—not one Chinese soldier could we find.

We then came out, and to this day I can recall the picture of the arrival of the Volunteers. From the interior of the yamen, as we went through one of the courts, the high and wide entrance seemed to frame the troops who were marching past it in fours, for all the world just like a "movie" on the screen.

The force then searched the barracks, which were drawn blank as regards men, but many weapons were found and brought out.

By this time the flagstaff which had been carried over, had been erected, and the troops formed up with bayonets fixed, and presented arms while the Union Jack was run up to the mast head, and the C.O. took possession of Kowloon City in the name of England. The Volunteer Artillery fired twenty-one rounds from their two little mountain guns. They did this well, for one gun refused to fire more than one round, but the other one was handled smartly, and got off a good salute that was heard in Hong Kong. The bulk of the force then re-embarked for home, and as the C.O. said to me when we got back, "one did not go out every day and take a bit of China between lunch and dinner."

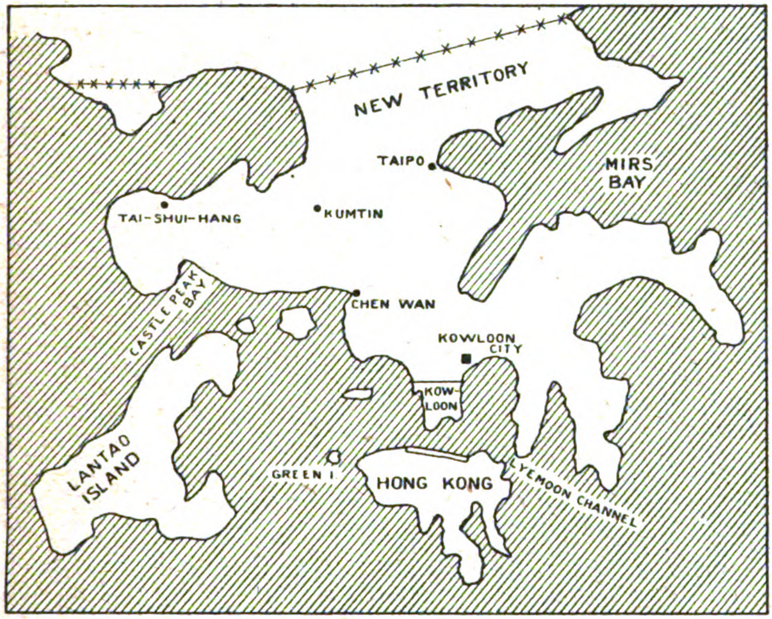
The City wall formed a large rectangle, and was high and thick, and strongly built of dressed stone. It had arched gateways, and was battlemented at the top. A large, old, muzzle-loading gun lay at each embrasure, but in real Chinese fashion they had no carriages, and simply reposed on the broad top of the wall, absolutely useless.

So I have the satisfaction of knowing that I have helped to add my bit to the Empire, and saw the transaction carried out.

The annexation of Kowloon City was preceded by what I like to call my first campaign—it sounds well. My share in it lasted four days, but an enemy was lacking to my party the whole time.

To put down the local rising that I have mentioned, several flying columns from the Hong Kong garrison over-ran the New Territory, and a little fighting occurred in which an R.A.M.C. officer was struck in the arm by a heavy bullet fired from a jingal.

In the late afternoon of April 18, 1899—nearly a month before the taking of Kowloon City—I was ordered to proceed forthwith to the military wharf, where I found myself in medical charge of a force under the command of the G.O.C., which embarked in launches and steamed out of the harbour by the S.W. or Green Island approach. I had four or five of our men with me, and, as we were a small party, we were put into the headquarters launch. In the middle of the night we stopped, and it was rumoured that the force would land under cover of darkness, to endeavour to surprise and capture a body of rebels that was supposed to be somewhere about.



A small boat was to leave our launch to survey the situation, and the D.A.A.G. said that it would just hold my party. As it had not occurred to me that an unarmed R.A.M.C. contingent would be selected to make the first landing on a coast that might have held an enemy for all we knew, and moreover one that cared not for Red Cross brassards, I had not my men just under my hand at the moment, and it took two or three minutes to collect them. By that time plans had been altered, and nobody landed, but the launches moved on.

After having covered nearly thirty miles, we arrived near a place called Tai-shui-hang, where the whole force disembarked, and proceeded to march across country towards Castle Peak Bay. Several villages were approached in attack formation, but all were deserted, and after a walk of about five miles we reached the sea again, and re-embarked without having seen a single Chinaman. As the expedition had failed in its object, owing to the

absence of the insurgents, the G.O.C. and the bulk of the troops went back to Hong Kong, but my party was detailed to accompany a small force of the Hong Kong Regiment—natives of India—to capture the walled village of Kumtin. To do this we steamed back towards home, for about twelve miles, to Chen Wan, where we landed, and then had a march of eight or nine miles into the interior before us, nearly all up-hill. About half-way we bivouaced on the open hillside, and in the forenoon next day reached our objective.

The village had a high, strong, well built stone wall all round it, with a beautifully fashioned iron gate, which it was rumoured afterwards found its way to England. It was really a remarkably fine piece of metal work to find in such a place. If the villagers had decided to fight they should have been able to put up a strong defence, but not a soul was visible except three old crones who were outside the gate, and who kept up a prolonged salaaming and kow-towing to us. It was decided to blow down the gate, just to show that we had been there. The old crones would not move very far, but when the charge exploded close to them, they toddled off as fast as they could, and were seen no more.

We then set out for Taipo, about nine miles away, where a base had been formed, but night soon came on, so it was decided to spend it at a small village that we came to.

There were only four officers in our column, an R.G.A. major in command, an officer of the Hong Kong Regiment, an R.E. subaltern, and myself, and we selected a substantial looking house for our billet. The village was deserted, while the front door of the house was bolted, and was strengthened by strong wooden poles stretching from the sill-stone to the lintel. The four of us congregated there, and as no notice was taken of our knocking, we concluded that the house was empty. The R.E. serjeant-major, a man of splendid physique, was sent for, and he arrived with an axe, crowbar, saw, etc., and prepared to break down the defences of the door.

At this point I remembered how disastrously Adrian Hope had fared in the Indian Mutiny by making a frontal attack on a strong place which he had not reconnoitred, and which had no defences at all at the rear, so I thought that I would make a reconnaissance myself, as nobody else seemed to think of doing so. I went round to the back, opened an unlocked door, walked through the house, undid the inner fastenings of the front door, and with a malicious grin flung it open in the faces of the rest of the party. They looked small at having been taken down like that by a non-combatant.

Suddenly another old crone materialized in the house, of which she had evidently been left in charge, and she salaamed and kow-towed like her sisters of Kumtin, but we took no notice of her, and had a look round the chief room. Finally she went off, and presently in the room itself came sharp reports one after the other—bang, bang, bang. Our first thought

was that we had fallen into an ambush in the house, and I have always considered that the way in which not one of us jumped, shouted or showed alarm in any way, did us great credit. The noise came from the explosions of a Chinese cracker which the ancient dame had lit and placed on the floor beside us, in order to propitiate us, and our interest in the apartment had prevented any of us from noticing her proceedings.

We had straw brought in and all lay in it on the floor, but we got very little sleep, for all night long orderlies from other columns kept arriving with reports for our C.O., and waking him up naturally disturbed us all.

Next day we arrived at Taipo, where I relieved the officer who had been hit some days previously, but, as the war seemed to be over, the force returned to Hong Kong by sea next day—a run of nearly fifty miles.

It had been a somewhat amphibious campaign ; in the four days I had embarked and disembarked three times, had spent one night in a launch, one in the open air, one in a billet, and one in a tent, and had traversed about twenty-three miles by land and some ninety by sea. We had not fired a shot or seen a live enemy, but had passed a couple of dead ones—one of them was so dead that we all passed him at the double. I couldn't think why everybody ran hard for about twenty yards when they reached a certain spot, but I did it myself when I got to the place.

My men found that it was hard work carrying stretchers, field companion, etc., up hill in a hot and steamy climate, in addition to their personal equipment, so when I noticed that they had impressed some youthful Chinese from a village as transport, I said nothing beyond advising them to watch their captives during the night. Next morning, on starting our last march, I was not surprised to hear that the transport had stampeded in the darkness, so my men had disconsolately to shoulder everything themselves. However, we soon sighted a village a little off our track, so I went into it to see what could be done. I was not sorry to see one of our sepoys, fully armed, follow me, and I came across an old man whom I rejected. In a house, hiding in a bed, I discovered a lusty young Chink, whom I commandeered amid much protestation and gesticulation. I had said nothing to my men, but, when I regained the path with my prize, I was amused to find that they had stopped to see what luck I had, as they seemed to guess my intentions. The sepoy brought in the old man that I had rejected, and he was soon jogging along with a field companion on his back, while the lusty young peasant rendered yeoman service with the heavier things, and progress was resumed with greatly increased cheerfulness.

Echoes of the Past.

THE DIARY OF COLONEL BAYLY, 12TH SUFFOLK REGIMENT, 1796—1830.

Extracted by MAJOR W. R. GALWEY, O.B.E., M.C., R.A.M.C.

THE magnitude of the last war and the numbers of the forces engaged dwarfs all previous campaigns, so that we are apt to imagine that never before was so great a strain put upon the endurance of troops nor their sufferings exceeded. The blaze of glory which surrounds the military operations on sea and land at the commencement of the nineteenth century blinds us to the appalling discomfort and sufferings which men endured at that time, owing to lack of organization of the supply and medical services and to ignorance of the most elementary facts of hygiene. The novels of Lever and Marryat depict life in the Services as one of rollicking adventure and take little account of the attendant privations and hardship. The soldier and sailor were there to fight; disease and discomfort were inevitable in war. Only a very few saw that these items were out of all proportion in the bill of costs.

Again, the terrific effect of modern artillery makes us imagine that no human being could be called upon to endure a more terrible ordeal than a concentrated bombardment. It is, however, at least doubtful whether this bombardment imposes a greater strain upon the morale of troops than actually seeing swift death or mutilation approaching in the shape of a bounding cannon ball and not being allowed to step aside to avoid it.

Such sufferings and endurance Colonel Bayly records in his diary—a human document which, without any attempt at literary polish, sets forth in plain language the experiences of an officer in a line regiment at the time when our Indian Empire was in the making.

He sprang from the stock which hitherto has provided the greatest number and the best of the officers of our Army—the English country gentleman. One can watch his development in the Service. At first, a care-free subaltern, keen on his profession and on sport; susceptible, with an eye for a pretty face and figure, but possessed of a shrewd commonsense which avoids serious entanglements of an undesirable nature; popular with his brother officers, though a little touchy on imaginary points of honour as was the custom of the day. Later, stress of service, wounds, illness, and the struggle of a comparatively poor man to rise in his profession without the aid of that highly-placed influence so necessary then for the attainment of high position embitters his mind and he records in no uncertain terms his opinion of the corruption and dishonesty of those in power which enabled less worthy but more fortunate individuals to obtain the rewards which his service and experience merited, but which he failed to obtain through lack of influential friends. One is glad, however, that at

last he attained command of the gallant regiment to which he gave the best that was in him.

He was gazetted as an Ensign in the 12th Regiment in 1796, and joined it at Newport in the Isle of Wight. He took lodgings with a friend, Woodhall, and celebrated his arrival with a few particular friends of his. "We all sacrificed pretty largely at the shrine of Bacchus, imbibing large potations of old Jamaica rum, mixed with hot water, sugar and lemons; unaccustomed to such potent beverage, I was soon laid prostrate under the table, and all sensation failed me until eight o'clock the following morning. I awoke thirsty, feverish and afflicted with a violent headache; I contrived, however, to dress myself and descended to the breakfast room, when to my horror and disgust Woodhall offered me a tumbler into which he had just poured a small quantity of rum. Never shall I forget the nausea this occasioned; an instantaneous faintness, and violent vomiting immediately ensued, and I am convinced that this simple experiment on my nervous system freed me during life from all propensity to that most destructive of all habits, the love of spirituous liquors; they were never after even named to me without creating a sensation of disgust." He certainly bought his experience cheaply, and his acute observation taught him later that the too free use of alcoholic liquors was the cause of much of the ill-health experienced during service in the tropics.

The training of the young officer was by no means light in those days and young Bayly quickly recognized that strenuous and prolonged study was necessary if he was to attain eminence in his profession. His zeal even led him to submit to thirty strokes of the cat-o'-nine-tails from his friend Woodhall, who apparently laid on good and hard and made so great an impression, both physical and mental, on the young Ensign, that he declares most solemnly that "I never attended a regimental punishment afterwards without being affected even to tears, nor did I even vote at a court-martial for more than three hundred lashes for the worst delinquent (a moderate punishment in those days), though often severely reprimanded by the President of the court-martial for want of consideration of the enormity of the crime and the inadequate punishment awarded! The remembrance of my feelings of pain was sufficient, and no menace ever compelled me to alter my opinion, and I have, thank God, lived to see this diabolical outrage to the mental and personal feeling of my fellow countrymen partially abolished."

In the intervals of his education he found time for fishing, fencing with his Colonel, attending county fairs, at one of which he and his friend Woodhall came out champions at a bout of backsword play; and finally for one or two encounters with the fair sex. In one of these, having gone too far, he received a sound drubbing from the lady's brother which effectually damped his enthusiam for some little time. He nearly became engaged to the belle of the Newport balls, a lady whom he described as equally distinguished for her mental and physical charms, but discovered in time

that in private life she was a seller of gingerbread husbands and marbles to the children of her native village. He naively remarks on this discovery "never did love evaporate with such a sudden flash."

In June, 1796, he embarked with his regiment for India and arrived at the Cape of Good Hope in the following September. As the stay of the regiment was likely to be somewhat prolonged before again starting for India officers were allowed to obtain lodgings ashore. Bayly made himself comfortable in the house of a Dutch padre—their only medium of conversation was Latin, but they appear to have got on very well together. So much so, that Bayly almost decided to marry the Padre's sister and settle at the Cape, but was dissuaded by his senior officer from doing so.

His first Indian station was Fort St. George, Madras. There the regiment went through the most vigorous training.

"From January to August we were drilled without intermission and soon became expert in military evolutions, perhaps superior to any King's regiment then serving in India. I recollect the gallant Colonel Baird attending our drills and expressing his unqualified approbation of our movements and high discipline. In six months the regiment was on the Eastern glacis every morning at daylight, and I never saw the rising sun so frequently and probably never shall during my existence. A 2 o'clock the subalterns were paraded in a long verandah of the King's Barracks, giving the word of command of "Ready, present, fire!" in a loud, firm and distinct voice to ten files of men placed at ten equi-distant intervals; then at 6 o'clock in the evening we were again manœuvred on the glacis. The guardhouses at Fort St. George, under the bomb-proof ramparts, were so infested by clouds of mosquitoes that I have often sat in a chair or paced in front of them the whole night, lamenting my infatuation of entering the Army or thinking on the happiness I might have enjoyed had I but accepted the proposition of my friend the padre at the Cape, when love, content and independence would have brightened my future life." Any one who has endured a hot weather in Fort S. George, Madras, can sympathize with such sentiments! What troops were called upon to endure in those days in a tropical climate without suitable clothing and equipment may be realized by the following incidents:—

"One morning, after a two hours' drill on the well-trod glacis of Fort S. George, the sun rose with its usual splendour; the heat was insufferable at 8 o'clock. The movements of the men from fatigue, appearing to the Colonel to proceed from neglect and indifference to duty, he kept us on the ground until 9 o'clock, when we returned to the Fort, *tout en eau*. As I entered my quarters I fell suddenly on my face, deprived of all sensation. My servants placed me on a couch; the surgeon was called, pronouncing my malady as a *coup de soleil*. My nose, on which I had fallen, bled profusely, and this circumstance, in his opinion, saved my life. The excessive heat and unusual long drill produced this affliction. The medical men represented the pernicious consequence of the troops being

harassed by long drills, exposed to the intense heat of the sun, when an order was issued restricting the exercise to a specified time and hour. Every day previous to this salutary prohibition, 3, 4 and sometimes 5 men would suddenly drop down in the ranks, as if shot through the heart by a musket ball and numbers died under the fatal influence of this severe affliction of *coup de soleil*."

The colonel of the regiment apparently did not learn much from these experiences, for shortly afterwards when the headquarters of the regiment were stationed at Tanjore with two companies at Fort Vellum, eleven miles away, he made them march three times a week to a plain equidistant from the two places and there drill for several hours. As Bayley remarks: "This arduous duty could not last long; five miles march to the drill ground, two hours' incessant evolution, and five miles home again under the fierce rays of a tropical sun was enough to damp the ardour and exhaust the physical strength of the most robust European. Many men were struck dead by *coup de soleil*, and four hundred lying in hospital afflicted with dysentery and other severe complaints. The representations of the surgeon on the imprudence of thus harassing the troops was unattended to; our hardy colonel continued the exercise, but he was always on horseback, and felt not the scorching sun; if he did it was not accompanied by that excess of fatigue and overwhelming exhaustion that affected those who were compelled to march. Many a time have I relieved a poor fainting soldier from the weight of his musket and carried it myself, bringing the perspiration in streams from my sodden clothes. On returning to the garrison, either from climate or excess of fatigue, two officers and upwards of one hundred men died, when Government interfered, issuing a peremptory order for the prevention of any future meeting between the two separated portions of the corps."

Apparently no blame was attached to the colonel, who continued to command the regiment till killed in a duel with his second in command!

Towards the end of 1797 the 12th Regiment with other corps was ordered to proceed to the Luconian Islands, with Manila as their objective. They got as far as Penang, but were recalled to take part in the operations against Tippoo Sahib, which culminated in the battle of Seringapatam. Bayly thus describes his provision for six months' consumption on the campaign: "I had two bullocks laden with biscuits, two with wine and brandy, two with my trunks, and four for the marquee, in addition to which a dubash, mealy bag, and six coolies to transport my couch, chairs, and various other little appendages. Thus I was accompanied by ten bullocks and eight servants, the majority of whom were followed by every individual of their family—grandfathers, grandmothers, uncles, aunts, nephews, nieces, with whole generations of children." If this was a subaltern's position, what must a general's have been, and we still marvel at the elaboration of the auxiliary services in the Great War! He received his baptism of fire at the action of Mallavilly which was fought

during the advance on Seringapatam. He describes his sensations as follows: "In this advance our captain of grenadiers, I suppose, observing the paleness of my countenance, turned round and offered me a refreshing draught from the contents of his canteen, composed of brandy and water, which I gratefully accepted. The military man may sneer contemptuously at this indication of pusillanimity, but never during all my service did I see soldiers enter on a scene of action with that calm, florid appearance denoting a sense of security and health. Individuals may hector and swagger, but mortal never existed exempt from the feelings of human nature. I affirm there is a palpable evident alteration in every man's appearance at the commencement of a battle."

The 12th Regiment was amongst the troops selected for the initial attack upon Seringapatam, the object of which was to take possession of of a dry sandy bed of a "nullah," and to occupy a wood at some distance to the right of the river Cauvery, which flows before the fortress. Colonel Bayly gives a vivid account of the operation, which must have imposed as great a strain on the morale of the troops as any in the recent war.

"Colonel Shaw's (commanding 12th Regiment) column had marched on slowly and cautiously for three-quarters of an hour when the whole atmosphere became suddenly illuminated with a brilliant blaze of light from innumerable fire-balls thrown forward by the enemy, who perceiving the exact situation of Shaw's force, then projected thousands of rockets and saluted us with repeated volleys of musketry, pouring death into our ranks. The light was brilliant but awful in its effects. The Tyger Sepoys (Tippoo's troops) were plainly observed in heavy masses in our front, and on both flanks pouring in a destructive fire; still this gallant little body moved slowly on, unintimidated by the numerous foe, although each moment more encumbered by the wounded. The rockets and musketry from upwards of 20,000 of the enemy were incessant. No hail could be thicker. Every illumination of blue lights was accompanied by a shower of rockets, some of which entered the head of the column, passing through to its rear, causing death, wounds, and dreadful lacerations from the long bamboos of twenty to thirty feet, which are invariably attached to them. The instant a rocket passes through a man's body it resumes its original impetus of force, and will thus destroy ten or twenty until the combustible matter with which it is charged becomes expended. The shrieks of our men from these unusual weapons were terrific; thighs, legs and arms left fleshless with bones protruding in a shattered state from every part of the body, were the sad effects of these diabolical engines of destruction. Not a shot was returned from our column, nor had the men even loaded their pieces; a caution from our cool old colonel that "all must be done by the bayonet" needed no repetition to ensure obedience. Scarcely had this order been conveyed through the ranks, when an increased and tremendous peal of musketry for several minutes was distinctly heard from the wood on our right, a certain indication that Wellesley's column was also seriously opposed.

This soon ceased, but immediately afterwards the rear of our right flank was turned, from whence the enemy poured in deadly volleys of musketry. Thus situated it became a paramount object to shelter our soldiers from this fresh accession of fire; they were therefore directed to lie down, as it would have been a wanton and useless sacrifice of the men's lives to stand and confront such a sweeping and formidable desolation. The enemy supposing from our recumbent posture, which was plainly exposed by the light of the fire-balls, that the majority were annihilated, a heavy column of Tyger Sepoys ventured a desperate attack at the point of the bayonet, and actually drove our sepoys in confusion on the Europeans, killing their commandant, Major Colin Campbell, and wounding many officers. As soon as we were liberated from the flying sepoys, who scampered pell-mell over our prostrate line, the command "Up 12th and charge" was a signal obeyed with alacrity, and we plunged headlong into the ranks of the swarming foe, springing on them like lions. The effect was magical; for the moment they discovered the white faces of our men, a general cry of 'Fringee boug Chuti! Fringee boug Chuti!' ensued. They were seized with a general panic, and scoured over the plain much more rapidly than they had advanced, and they were scattered in all directions. The murderous rockets and musketry still showering from other quarters we were soon compelled to resume our prostrate manœuvre, and thus remained for several hours patiently awaiting the dawn of day."

In the meantime the force under Colonel Wellesley, afterwards Duke of Wellington, had failed to obtain its objective, and he himself broke down and returned to camp in a state which, as Colonel Bayly justly points out, would have entirely ruined the career of an officer with less influential friends. The colonel does not spare the future Duke, and his bitterness may well be understood since Wellington's failure led to the murderous attack on the right flank of the 12th and threw the whole brunt of the operation upon that gallant corps.

To return to Bayly's narrative: "We now only awaited the dawn of day to exhibit one of the most glorious and impressive scenes that ever added lustre to the British annals of military fame. The whole army in the encampment was drawn up, and just as light appeared the 12th Regiment, with the battalion of sepoys, were plainly discovered advancing in line towards the bed of the river, opposed by clouds of the enemy, and a heavy canonade from the fortress of Seringapatam. The resistance was certainly of the most imposing and formidable description, and the result anxiously attended by our gallant comrades in camp, whose glasses and eyes were fixed on the dubious scene in commiserating suspense; every heart thrilled with hope and best wishes for our success. At length the 12th, supported by the sepoys, dashed into the bed of the river, and all was involved for some minutes in a mass of confusion; the attacking force was absolutely hid from view; crowds of the enemy in front, flanks and rear obscured their apparent existence; our exertions and courage were certainly put to

the test. There was not a single idle bayonet; oaths, shouts, and carnage presented a terrible scene of human ferocity; never did men more heroically perform their duty. The conflict was excessively murderous and obstinate, as the Tyger sepoys were brave, numerous and well-disciplined. For some time the combat appeared dubious, as a considerable body of French troops persevered in most gallant style to lead on Tippoo's sepoys; this did not continue of long duration, for Colonel Shaw, attracted by the obstinate resistance of the French, directed our Grenadiers to charge them, when they turned and fled with precipitation. This example was followed immediately by the surrounding enemy, and we pursued them some distance beyond the nullah, but the shots from the fort played on us so rapidly that we were soon compelled to return and shelter ourselves under its banks. The admiration of the Army was vividly excited, and General Harris was heard to exclaim, 'Well done, old 12th; why, they are going to take Seringapatam.'"

An officer of the regiment during the course of this action received an extraordinary wound from which he died. He was shot in front of the right hip, and the dhooly bearers who carried him to camp complained of the great weight bearing on the right side. After his death at the post mortem examination a wrought-iron shot of 26 lb. weight was extracted from between the bones of the thigh.

After the capture of Seringapatam, the 12th Regiment was stationed at Wallajabad and thence moved to the Malabar Coast. At the former place Bayly remarks that there was the finest snipe-shooting in the universe, for those who did not mind wading for hours up to their knees in black slimy mud under the fervid rays of a tropical sun. Such sportsmen assuaged their constant thirst by brandy and water—one individual alone was frequently known to consume the contents of three bottles of brandy in the course of a morning—and by repeated draughts of sangaree—a tumbler of madeira, sugar and nutmeg diluted with a wineglass of water. The Colonel shrewdly says: "I defy the most robust European constitution to resist the effects of such excessive excitement, yet the fatality occurring in consequence is invariably attributed to an insalubrious climate. Nothing can be so inconsistent and unjust, for I am perfectly persuaded that diseases are neither more numerous nor inveterate than in Europe, provided we pursue that regular course of living generally adopted by our countrymen in England, from which they consider themselves licensed to depart in a warmer clime, and thus become victims to their own imprudence rather than to the noxious vapours or climate of India."

All the same the effects of exposure and active service had undermined his constitution and "a severe affection of the liver complaint for which I was repeatedly blistered, bled, and surfeited with poisonous calomel," compelled him to apply for leave of absence to return to England. This being granted, he, with a friend named Seton, booked passages at a cost of £300 apiece on board a Chinaman, the "Ceres," homeward bound via Penang and

Canton. After paying so great a sum he was disconcerted to find on arrival at Canton that he and his friend were obliged to hire a bungalow at a cost of £100 while the ship was laid up.

It is impossible within the scope of a review to detail all the incidents of Bayly's adventurous career, and it must suffice to say that on this voyage and during his subsequent sojourn in India he went through sufficient perils and had as many hair-breadth escapes as would furnish copy for a library of tales of adventure.

At Malacca he rescued a lady from drowning in the surf; and afterwards renewed the acquaintance at Bath where "all-powerful love overcame every prudential consideration, and in eleven months I became the proud father of twins, and in seven years the distressed but still happy husband of this amiable woman, with a family of nine children."

While he was in England he was employed in recruiting duties connected with the raising of a reserve force to meet Napoleon's expected invasion of England; and was nearly ruined by a dishonest sergeant who disappeared with a large sum of money which Bayly, much to his agitation and discomfort, was obliged to hold for payment of his men. Prompt pursuit, however, resulted in the capture of the delinquent and the recovery of the cash.

At this time a great blow was dealt to his hopes by finding that his father had dissipated his property through speculation, so that he now became almost entirely dependent upon his pay. He says: "I can only regret the infatuation which ruined my prospects in life, by rendering my profession a source of emolument, instead of a display of patriotic enthusiasm."

There was nothing for it but to rejoin his regiment and he embarked with an aching heart for the shores of India in October, 1806. His wife was confined of her fourth child a week prior to sailing, so that the further expense of the passage for her and their children at a later date—a sum of £500—was added to his burdens. Constant moves, then as now, were the bane of the married officer, and on landing at Madras he found an additional expense awaiting him since he had to transport his wife and family across to Cannanore on the Malabar coast—a journey now accomplished in some sixteen hours by rail, but then involving many "daks" through the malarious and savage Wynaad.

Hostilities being imminent between the Company and the Rajah of Travancore, on Christmas Eve, 1808, the 12th Regiment received orders to proceed to Quilon, with the usual official commentary that the move was to be carried out as economically as possible. Bayly describes graphically how the economy was effected at the expense of the troops—a happening not without its parallels in more recent time.

"The whole battalion was on board twelve patamars (open boats from forty to 100 tons burden), and the flank companies on an old country-built brig. With the exception of four boats, the others were all leaky consequently not seaworthy. . . The vessels were excessively crowded

as a proportion of followers, consisting of cooks, lascars, and officers' servants accompanied the troops. . . Rice, salt fish, and arrack were the only provisions provided for the voyage. In two or three boats there was a quarter cask of arrack; the others were unprovided with this essential article, which, when properly diluted with water, contributes materially to the health of the soldiers. The unequal distribution of this liquor caused much inconvenience and distress during the voyage, for when the fleet stood out some distance from the shore, the agitation of the sea became so great as to prevent all communication, so that those boats unprovided with this essential stimulant were necessitated to remain without it for several days. The situation of the troops was distressing in the extreme, from this confinement to one position, without the possibility of reclining the body in a recumbent posture, or taking any refreshing slumber, being absolutely wedged together without awning or covering to defend them from the scorching rays of the sun (which are reflected from the sea with double fierceness), or the baneful and heavy dews of night, which with the deadly land winds blowing off the shore, were sufficient to injure the most robust constitution in a very few hours; the natives, when exposed to the influence of this wind during the night, are frequently deprived of the use of their limbs during life, which are withered and distorted in the most awful and unaccountable manner. The short and rapid motions of the vessels produced the most violent sensations of nausea; the disgusting effluvia proceeding from those affected soon compelled those of stronger stomachs to yield to the prevailing malady, and thus sitting opposite each other in a cramped and confined position, the scene which ensued beggars all description; even whilst labouring under the effects of these complicated miseries, these gallant sufferers refrained from the expression of the least complaint, except a little regret for the loss of the accustomed dram of arrack which might have cheered their spirits amidst the evils they endured." Such was the treatment meted out to its soldiers by a Government which a few decades before had held up holy hands in horror at the savagery of the Black Hole of Calcutta.

Under these conditions the troops reached Quilon to embark on a campaign as arduous as any which has ever been undertaken by British troops. The small British force at first encamped upon a small plain about a mile in circumference and 400 yards from the sea, but were eventually, owing to pressure of superior numbers, compelled to retreat to an old dismantled Dutch fort. No sooner had they occupied it than a tremendous storm arose. "The morning of January 1, 1809, was ushered in by the most lamentable scenes that can be imagined. Let the man of feeling picture to himself a small delapidated fort, a mile and a half in extent, of triangular shape, over two sides of which the sea was dashing its raging billows with irrepressible fury, and on the ramparts 1,500 British troops, exposed to all the inclemency of a storm of wind and rain, beyond the comprehension of those unaccustomed to a tropical climate; fifteen thousand

followers, principally the wives and children, and families of the sepoys, occupying the area of the triangle (where they had sheltered during the night from the dread of a still more remorseless enemy), running about in the wildest confusion, and uttering the loudest lamentations of despair, which with the roaring of the sea, the wrecks and dead bodies scattered on the shore, and he will have a faint idea of one of the most impressive and terrific scenes that ever history recorded.

* * * * * * * * *

"Never were troops more scantily attended or equipped than the Army in Quilon, not a single bullock or conveyance for guns or baggage of any description; then we were exposed to the united efforts of the armed population of Cochin and Travancore, without the possibility of retaliation, in the event of obtaining any partial success, which could not be taken advantage of for want of carriage."

Yet this force not only held its own against overwhelming odds, but inflicted a severe defeat upon the enemy which gave the politicians an opportunity for negotiations which succeeded in detaching the Rajah of Cochin from Travancore, and finally compelled the latter to capitulate and sacrifice his Dewan to his conquerors. Colonel Bayly considered the Nares or Travancoreans the bravest race in the peninsula of India, and had their knowledge of military tactics equalled their natural animal courage, the East India Company could never have conquered this inaccessible country. Immense sums of money were extracted from the unfortunate Rajah of Travancore, but none of it was given to the troops as prize money, because, forsooth, they were quelling a rebellion; nor was it expended in bettering their wretched lot.

On May 12, 1809, the 12th Regiment was ordered to march without delay from Quilon to Seringapatam through the Travancore country. The monsoon had already commenced. On May 20 they began their march. "With extreme difficulty four short marches were effected, when the whole marshy part of the country having become inundated, presented an insurmountable obstacle to the further progress of the regiment, until a partial cessation of rain should enable them to proceed. It had not been without the greatest efforts of courage and perseverance that even this short distance had been accomplished; the provisions, tents and new clothing had been all destroyed, and many of the officers lost every atom of their baggage. So thoroughly saturated was every denomination of stores and wearing apparel, that not a single article remained free from a state of utter decomposition, lying absolutely in smoking piles, with muskets, bayonets and other arms, all so rusty that, in the existing humidity of the atmosphere, it was impossible to preserve them from the corroding filth. For three weeks the regiment occupied one little hillock, surrounded by floods of water, and exposed to incessant torrents of rain, the trees and a few old Nares' huts being the only shelter in this unprecedented and deplorable situation."

Soon after the regiment lost its remaining baggage in crossing a flooded river. "New tents and provisions were at length supplied, but too late to preserve thirty to forty Europeans who had already been carried off by dysentery, of which disease 300 more were affected, promiscuously strewing the ground with their dying carcases; it, however, preserved them from actual destruction."

Such was the state of the corps that the authorities were at length sufficiently aroused to allow it to proceed to Trichinopoli, then considered the healthiest station in India.

Bayly had been wounded in the battle of Quilon, and was, fortunately for him, unable to accompany the regiment on its awful march. He proceeded with his own carriage to Seringapatam, the original destination of the corps. There he became spectator of a mutiny of the Companies' troops against the civil authorities, a disgraceful state of affairs for which he blames the then Governor of Madras, Sir George Barlow, whom he describes as corrupt and unscrupulous.

In May, 1810, he embarked with his regiment for the expedition which resulted in the capture of Bourbon and Mauritius. There he did his part in some stiff fighting, and after the cessation of hostilities, became commandant of S. Paul, a post which he lost from too active zeal in the suppression of the slave trade.

On November 17, 1817, he landed with his regiment at Plymouth, and at once received orders to proceed to Ireland. Here the treatment meted out to soldiers was little better. After twenty years' service in India and six months' confinement on transports, the regiment was marched from Cork to Athlone in mid winter. "Here a Bond Street Major-General, by name Buller, commanded the garrison. The regiment was thrice a week paraded for his inspection, waiting sometimes for two hours and upwards, with the snow driving in the men's faces, in heavy marching order on parade, when an aide-de-camp would dash up on a fine prancing horse, informing the commanding officer that the regiment might be dismissed as the general was indisposed."

The result of this treatment was that the old soldiers applied for the discharge to which they were entitled, and the unit soon became a corps of raw boys.

Disgusted at this state of affairs, Bayly determined to retire, but finding that his father had dissipated all that remained of his property, he was obliged to continue on the active list. He was now a widower, and had lost several of his children. Much against his will he found himself once again under orders for Gibraltar, where he succeeded to the command of the regiment. But his last days of service were fated to be unhappy ones. A fearful epidemic—which he calls yellow fever—but which was apparently cholera, visited Gibraltar in the autumn of 1828, in which some 800 men perished. In spite of the efforts of specialist-medical officers, including a learned French practitioner named Chervin, who infected himself experi-

mentally, but recovered, the epidemic did not abate until the arrival of the cold weather.

During the whole of this dreadful period Colonel Bayly carried out his duties as a field officer of the garrison, visiting guards and hospitals, though the latter were regarded as veritable death traps.

At length, at the age of 50, he retired, after thirty-four years' service with the 12th Regiment, to enjoy a well-earned rest in the evening of his life.

His diary, recording as it does on every page tales of endurance and devotion to duty, is a wonderful illustration of the spirit which has permeated the British Army, and has enabled it to accomplish tasks which at first sight have appeared beyond the power of men.

[The Editors are indebted to Major H. C. Hildreth, D.S.O., R.A.M.C., for the loan of the Diary from which this abstract is compiled.]

Current Literature.

Plurality of Syphilitic Virus. By C. Levaditi and A. Marie. (*Annales de l'Institut Pasteur*, xxxvii, No. 2, February, 1923, p. 189.)—The authors maintain the thesis that the para-syphilitic manifestations (tabes and general paralysis) are due to a distinct variety of *Treponema pallidum*, but do not offer evidence as to whether differentiation is acquired subsequent to infection or whether it is pre-existent. Comparative inoculation and immunity experiments on rabbits, monkeys, and men are described using neurotropic and dermotropic strains of treponema as well as *Spirochæta cuniculi*, the organism found in a disease occurring naturally in rabbits and closely resembling primary syphilis in its manifestations and means of transmission. All three organisms were found to be pathogenic for rabbits when inoculated on the mucous membrane, but they showed definite and consistent differences in the nature of the lesions produced. The neurotropic treponema (obtained from the brain of a case of G.P.I.) and *S. cuniculi* were found to be non-pathogenic for monkeys and man when inoculated cutaneously by scarification. But the dermotropic treponema, even after it had been carried through a series of rabbits for fourteen years, was still pathogenic for both men and monkeys but showed greatly reduced virulence and produced no secondary or tertiary manifestations. Immunity experiments with rabbits showed that each organism produced immunity against reinfection with the same organism but no cross-immunity was produced between any of the three.

The Treatment of Sleeping Sickness by Atoxyl. By Ouzilleau and Lefrou. (*Annales de l'Institut Pasteur*, xxxvii, No. 3, March, 1923, p. 275.)

Attempts at Treatment of Sleeping Sickness in the Second Stage. By Lefrou. (*Ibid*, p. 294.)—In the first stage of the disease three methods of dosage were tried :—

(1) Small doses of 0·01 gramme per kilo of body weight with a maximum of 0·5 gramme at intervals of five to seven days.

(2) Medium doses of up to 0·75 gramme at intervals of fourteen days.

(3) Large doses of up to 1·25 gramme at intervals of fourteen days.

In all three methods tartar emetic was given in doses of 0·05 to 0·1 gramme with, or alternately with, the atoxyl.

The results with the first two methods were unsatisfactory, 39 cases treated with small doses all relapsing. Among 44 cases treated with medium doses, 3 had no relapse up to two years after ceasing treatment, and 14 relapsed very shortly after treatment was stopped. The remaining twenty-seven were put on the third method of treatment without waiting for relapse. The cases treated by the third method comprise 102 who had already been treated by small or medium doses, and eighty-four who had had no previous treatment. In these two groups there were 13 and 5 relapses respectively during a period of observation of from seven to twelve months in the case of 22 of them and twelve to seventeen months in the remainder.

The authors deny that these large doses are attended with any danger but advise giving Europeans a small trial dose to ascertain whether there is any idiosyncrasy.

Owing to the small margin between the dose toxic to the trypanosome and that which is toxic to a damaged central nervous system, the treatment of the second stage by atoxyl, neosalvarsan, or other form of arsenic tried was far from satisfactory and the most that could be hoped for was to keep the peripheral circulation free from trypanosomes by courses of large doses alternating with periods of rest. By this means a progressive reduction in the lymphocytes of the cerebrospinal fluid was obtained, a fall occurring during treatment followed by a slight rise in the period of rest. In the second stage of the disease doses of more than 1·0 gramme were found to be attended with danger.

A Preliminary Report on the use of Creosote Oil as a Mosquito Repellent. By C. P. Coogle. (*Public Health Reports, U.S.A.*, xxxviii, No. 10, March 9, 1923, p. 443.)—Observations made indicate that creosote oil, when applied to the walls and ceilings of certain houses in the quantity of one gallon to 420 square feet, will noticeably repel anopheline mosquitoes. The duration of its effectiveness is yet to be determined.

Observations made of certain of the cresoted houses ten weeks after the creosote had been applied seem to indicate that the creosote oil was still effective.

It appears that creosote oil as a mosquito repellent is particularly

applicable to and desirable for use in houses of poor construction, where screening and other anti-mosquito measures cannot be effectively employed.

Apparently the employment of creosote oil in the quantity and manner indicated above is perfectly safe. No ill effects were noted upon any of those who slept in the rooms subsequent to the application.

One observation seems to indicate that creosote may be used to prevent mosquitoes from laying eggs in water barrels. A water barrel that had formerly contained creosote was on several visits found to be free from larvæ although they were very abundant in two adjoining barrels. There was no film on the water at the time but a faint odour of creosote was perceptible. The occupant of the house, a negro woman, stated that there had never been any wiggletails in the third barrel since she brought it home four years ago when it had been given her by a man who had used it for creosote.

Hookworm Disease among Persons who were cured five years ago. By D. L. Sisco (*Journ. Amer. Med. Assoc.*, vol. lxxx, No. 7, February 17, 1923, p. 451).

Carbon Tetrachlorid in the Treatment of Hookworm Disease. By S. M. Lambert (*ibid.*, vol. lxxx, No. 8, February 24, 1923, p. 526).—Sisco describes in an area of the Island of Antigua, British West Indies, a resurvey of the treated population. This showed in effect that all the people who had been freed from hookworms five years previously were reinfected to the same degree as they were at the time of that campaign. Therefore (1) "No treatment work should be started in an area which has not been previously sanitated. (2) The construction of latrines is only the beginning of sanitation. (3) Treatment work should not be discontinued until a permanent organization competent to control operations, and to maintain public health education, sanitation and treatment is functioning."

Lambert's paper presents rather full evidence drawn from 50,000 treatments with carbon tetrachlorid. This drug has shown itself to be the best vermifuge for the treatment of hookworm disease where *Necator americanus* predominates. It is palatable, requires no preparation of the patient, and when pure is apparently not toxic, all of which features are of advantage in a popular campaign; 42,000 persons were treated without morbidity or mortality from the drug. Among 8,000 cases subsequently treated with supposedly pure carbon tetrachlorid three fatalities occurred. Chemical examination, however, disclosed that this particular lot of the drug was far from pure. It is important, therefore, to make sure that a pure supply is used. It is possible that the dosage employed, viz., three minims for each year of age, with an adult dose of forty-five to sixty minims, is larger than is desirable. Where there is a heavy infection of ascaris, the results are improved by the addition of oil of chenopodium.

Method of Triple Centrifugation of Blood. By M. Blanchard and G. Lefrou. *C. R. Acad. Sci.*, October 9, 1922, vol. clxxix, No. 15, pp. 602-604.—Blanchard and Lefrou whilst engaged on their work on hæmorrhagic jaundice and relapsing fever had occasion to utilize the method of triple centrifugation of the blood—a method in common use at Brazzaville for the diagnosis of sleeping sickness--and an opportunity arose to examine the blood of Europeans suffering from blackwater fever by the same method.

The exact technique used by the authors is as follows:—

About ten cubic centimetres of venous blood is collected into a centrifuge tube containing one cubic centimetre of twenty per cent sodium citrate solution sterilized in an autoclave, and the mixture well shaken to prevent coagulation.

The blood is then subjected to three successive centrifugations, each of a duration of about ten minutes, in a hand centrifuge at a speed of 1,500 revolutions—about sixty-five turns of the handle per minute.

(1) The first results in the separation from the plasma of the greater portion of the red cells. The centrifuge should be stopped when the liquid is separated into two distinct layers—the lower red consisting of erythrocytes and the other amber consisting of plasma.

(2) Withdraw the supernatant layer by means of a pipette and teat and transfer to a second tube and centrifuge until there is a distinct red deposit: this consists of red cells, leucocytes and platelets.

(3) Decant, by pouring, the supernatant fluid into a third tube and centrifuge until a slight white deposit is obtained: this deposit, if the operations have been properly performed, consists only of platelets and an occasional red cell. It contains the spirochætes.

This deposit is removed by a fine pipette, the tube being inverted and almost vertical, so as to have as little dilution as possible, and is examined either fresh by means of the ultramicroscope or after staining.

By means of this technique the authors succeeded in finding spirochætes in the blood of two cases of blackwater fever. In the first case—a Swiss who had lived in the Congo for five years—the organisms were found on the fourth day of the disease, and in the second case—a Frenchman who had lived in the Congo since 1919—the spirochætes were found also on the fourth day.

The Heat Resistance of Bacillus botulinus Spores. *Abstracts of Bacteriology*, vol. vii., January, 1923, No. 1, p. 16. By J. Russell Esty. —The heat resistance of 112 strains of *B. botulinus* including 81 Type A, 30 Type B and 1 non-toxic strain varies from 3 to 75 minutes at 105° C. The spores are produced in pea-peptic-digest pH 8·0 and heated in a phosphate solution of approximately pH 7·0. The strains originated from twenty-nine outbreaks of human botulism and sixteen outbreaks of animal botulism, in addition to numerous other sources, such as suspected canned foods, raw plant products, soil specimens and material from forage poisoning cases.

The heat resistance of eighty-one Type A strains varies 3 to 75 minutes at 105° C. with an average resistance of 41·1 minutes. The resistance of thirty Type B strains varies from 3 to 60 minutes at the same temperature with an average of 23·8 minutes. The resistance of one non-toxic strain is thirty minutes.

The maximum heat resistance of *B. botulinus* spores produced under optimum conditions of growth is 330 minutes at 100° C.; 110 at 105° C.; 33 at 110° C.; 11 at 115° C. and 4 at 120° C. when heated in a phosphate solution of pH 7·0. These figures represent the time in minutes at which no spores have survived. The longest survival time at the same temperatures and under identical conditions is as follows: 320, 100, 30, 10 and 4 minutes respectively.

Spores of *B. botulinus* are more heat-resistant than those of the other anaerobes thus far tested.

The heat resistance of different strains of *B. botulinus* varies irrespective of the numbers of spores produced in the same medium. Few spores of certain strains may be far more heat-resistant than large numbers of other strains.

The heat-resistance of the same strain is markedly influenced by the numbers of spores heated. The larger the number present in a suspension, the greater the resistance.—*Author's abstract.*

Reviews.

TRANSLATION OF SELECTED PASSAGES FROM DE L'AUSCULTATION MEDIATE. First Edition. By R. Theophile H. Laennec, with a Biography by Sir William Hale-White. London: John Bale, Sons and Danielsson. Pp. ix and 193. 12s. 6d. net.

"In this astonishing book there occur perfect, precise and original descriptions of clinical symptoms and post-mortem appearances, neither too long nor too short, for the most part as true now as on the day they were written." A perusal of the excellent biography leaves the reader still more astonished at the achievements of this wonderful man. Handicapped by wretched health, and suffering from asthma, insomnia, neurasthenia, and later phthisis, plagued and harassed by family troubles, Laennec completed labours of almost incredible magnitude. He invented the stethoscope and established the art of auscultation of the heart and lungs. Tubercle he showed to be a new formation, and demonstrated the tuberculous nature of phthisis. He discovered the parasitic origin of hydatids. His studies on morbid anatomy are too numerous to mention, and his fame as a teacher attracted students from all over the world. He studied Greek to read Hipprocrates the better, and often spoke in Latin for the benefit of those who could not understand French. Amidst his

divers activities he had to waste valuable time in defending himself against the scurrilous attacks of jealous detractors, "but," says the biographer, "time has put all these people in their proper places."

Even in his hobbies Laennec showed the same infinite capacity for taking pains. A Breton by birth, family affairs removed him from Brittany at an early age, and so he reached manhood having entirely forgotten his native tongue. When later he decided to relearn Breton he studied with characteristic thoroughness the cognate Celtic languages, Cornish, Irish and Highland Gaelic so as to see Breton in its proper perspective.

Laennec was far removed from the austere and soulless scientist, and had in his composition a very active leaven of humanity. The rich were often sent away from his crowded consulting rooms unseen, but the poor, never. When typhus broke out amongst the sick and wounded in Paris in 1814, he collected amongst them all those Bretons who could not speak French, looked after them himself with infinite kindness, and persuaded the authorities to send a Breton-speaking priest to minister to these unfortunates.

Broken in health, Laennec retired to Brittany in 1819, and went to reside in his old family manor house of Kerlourarnec, where he hoped to spend the rest of his life in peace. Unfortunately, after a stay of two years financial and other reasons compelled his return to Paris where he was soon in harness again, and hard at work writing, teaching and engaging in practice. Four years later he retired again to his beloved Brittany, but this time only to die. He sank gradually, and on August 13, 1826, this great man passed away at the early age of 45.

Sir William Hale-White is to be congratulated on this volume which enables us to see as a living man one who was previously to many of us merely a name. W. P. M.

Remembering and Forgetting. By T. H. Pear, M.A., B.Sc., Professor of Psychology in the University of Manchester. Methuen and Co. Crown 8vo, pp. 236. Price 7s. 6d.

As used in popular speech, memory may mean impression, retention or recall, either separately or collectively, but to the psychologist memory is the act of recall. To the ordinary man who asks, "What is good memory?" this book attempts to give the answer and also to explain why we forget. The author begins by making clear the whole apparatus of remembering, that is, the reader is introduced to after-sensations, primary memory images and memory after-images. The psychology of imagery is of particular difficulty to the beginner, for it is here that he obtains his first vivid glimpse of the significant differences which may exist in the mental apparatus of his acquaintances. For the psychologist, the word "image" characterizes not only the experiences of the mind's eye, but also those recalled through the mind's ear, the mind's muscles, the mind's nose, in short, through any one of the numerous sense-organs both inside and outside the body. There are, moreover, images or revivals of experiences from the inner organs, particularly from those of sex, nutrition and excretion; and it is obvious

to everyone that they play an important part in contributing to, if not actually providing, the emotional type of memories. The author handles the subject simply and lucidly, leading the reader step by step to a right comprehension of the relation of sensation to perception, the real nature of the percept, of the image and of the real function of the image. The section which deals with this latter topic appears to us to be particularly good, for it brings out the relative independence of image and meaning, doing full justice to Washburn's theory of imageless thought. Once the reader has grasped the real function of the image he is in a position to understand the modern study of that carnival of images, commonly called a dream. Some seventy pages are devoted to the mechanism and analysis of dreams and make most interesting reading.

A feature of modern psychology is the stress laid upon the question of how and why we forget. This is justifiable as it is the field in which the clues may be found for a better understanding of many psycho-pathological conditions. Admittedly, it is a difficult subject, but the newer ideas regarding logical and affective relevant memories, upon suppression on the one hand and repression on the other, are well discussed in this book, particularly in relation to Rivers's theory of fusion. The author is quite good upon some different kinds of aspects of forgetting and suggests a classification of his own for forgotten experiences, which he groups into either embodied, exiled, superseded or retired. We confess some sympathy for this nomenclature and certainly prefer the terms to many used by French, Janet, Nunn, Prince and Jung. Many would-be students of psychology are repelled from a further pursuit of the subject by the constant use in the literature of terms which fail to convey to them any meaning. In this respect, this book is refreshingly free from ambiguity or complexity of nomenclature.

Not the least interesting section of the volume are the chapters dealing with number-forms, coloured hearing, synæsthesia and kinæsthesia. There is a practical tone in these chapters which will appeal to many and should bring home to the least sophisticated the rôles which different kinds of imagery play in æsthetic appreciation and the causation and the cure of mental disorders. It is the same in respect of kinæsthesia, by a study of which there is much to support the view that muscular skill may have a higher intellectual value than is usually assigned to it. Although our scientific knowledge of this subject is at present small, the claim seems justifiable that certain didactic systems widen or train the mind by virtue of the fact that they promote the cultivation of muscular knowledge. Some typical examples are handwork, some of the Montessori methods, eurhythmics, dancing, musical performance, painting and all the arts which demand delicate co-ordination of movements.

Founded originally on lectures delivered to officers of our Corps, this book has been developed so as to constitute not so much a textbook as a guide-book to some of memory's most interesting facts. Its value lies in the fact that it can appeal not only to the doctor but to the general reader. To the former it gives help to link up normal psychology with psycho-analysis, to the general reader it helps to connect the discoveries of modern psychology with many of the occupations of ordinary life. We have read the book with pleasure and frankly commend it as an eminently readable and not too erudite an introduction to the study of psychological problems.

R. H. F.

Un Hôpital Militaire à Paris pendant la Guerre: Villemin 1914-1919. Par F. Lejars. Paris: Masson et Cie. 1923. Pp. 364. Price 10 fr.

Under this title we are told how a "chirurgien civil" who had had but the slightest acquaintance with military medical matters finds himself at the outbreak of war suddenly invested with military functions and charged with the duties professional and administrative of a large hospital in Paris.

He recounts his experiences, his reflexions, and offers frank and practical criticisms and suggestions.

No light task faced Surgeon Lejars. The Hospital Villemin, which in five years of war treated in its wards over 30,000 cases with a mortality of 2·7 per cent., was part of an ancient convent, later it had been used as a military hospital but had been condemned as unfit for such twenty-two years before the outbreak of this war. Trained staff he had none. Such obstacles and many others might well have crushed men of less devotion and steadfastness, but with this chief and his staff, obstacles and difficulties arose only to be overcome.

The author tells how from want of training in military matters during peace time they found themselves heavily handicapped on the outbreak of hostilities and how he soon found that what many (usually they are those who have no administrative responsibility) called Red Tape, namely the compiling of returns of the sick, of expense, the indenting for what is necessary, etc., all had to be mastered if administration was to be efficient.

Hospital Villemin received the wounded "non-opérés" direct from the line.

The account of the arrival and treatment of the streams of casualties in the first week of the Marne battle is well told. Hospital wards, staircases, vestibules, even the courtyard crowded with stretcher cases taxed to the utmost the resourceful staff, but as the writer well puts it, "in moments like this one's passionate wish to be of service doubles one's strength and resource." Hundreds of our medical officers who served in field ambulances and casualty clearing stations will bear this out.

Monsieur Lejars offers many helpful suggestions as a result of his experiences. He pleads for a systematic instruction in peace time of all civil medical officers and personnel in military medical duties, which they will certainly be called on to undertake on mobilization. At present, in the French medical administration collaboration between the regular and civil medical officers ceases once demobilization takes place. He advocates the posting of selected civil surgeons to definite hospitals in peace time, so that when required for war work, the hospital can function at once.

He pays generous tribute to his various helpers who worked so devotedly through those trying five years and who made hospital Villemin the blessing and success it was.

Instructive tables and text are given of the various types of wounds treated in this 550-bed hospital, also analyses of cases of gas gangrene, amputation and tetanus.

Many pages are allotted to the subject of the smaller and subsidiary hospitals, also private houses, etc., acting as auxiliary and overflow hospitals. He shows how the number of these runs up and how difficult it is to exercise proper control and supervision over their work, how costly they are in management and wasteful of personnel. Hospital Villemin had attached to it forty-three subsidiary hospitals.

A well placed, well equipped hospital of 500 beds will always deal more satisfactorily and with many more cases than can ten subsidiary smaller hospitals of fifty beds each, and at half the expenditure of time, personnel and money.

Sound advice is offered as to the selection and recruitment of women and men as nurses. Nursing is a "métier," a profession, and only to be learnt in practical duties in a hospital.

The object, work and scope of the great Red Cross Societies of France should be the instruction and practical preparation of the greatest number of women possible to nurse the sick in times of emergency.

The chapter telling us of the provision made for safeguarding patients in hospital from air and Big Bertha bombardment is most interesting. In future, provision of underground refuges, cellaring, etc., will have to be arranged in the building of all hospitals whether to be used for civil or military purposes.

The later portion of the work is chiefly narrative of the life and work and interesting daily events in the hospital Villemin. Such as the encouragement, sympathy and help given to patients and staff by the visits to Villemin of Monsieur Clemenceau, the President of the Republic; General Gallieni, Governor of Paris, and others. As a Commanding Officer he forms a high opinion of the value of strict and surprise inspections of hospitals by senior officers, and states what is most true—that "to command a unit well it is necessary that those you command recognize that you yourself are commanded."

The book is attractively written and contains much that is useful to the authors' brother medicos of all nations. Many of the difficulties he encountered had to be faced by our older medical officers in previous campaigns. Our experience, however, gained in the comparatively recent wars in Egypt and South Africa had resulted in bringing our administration more up-to-date than that of the French who had undergone no war trials since 1870.

G. A. M.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subcriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to THE HON. MANAGER, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," WAR OFFICE, WHITEHALL, S.W. 1.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C. 2.

VOL. XLI. OCTOBER, 1923. No. 4.

Journal

of the

Royal Army Medical Corps.

Original Communications.

A MODIFICATION OF DR. CHARLES CREIGHTON'S VIEW OF MALIGNANT GROWTHS.

BY H. M. WOODCOCK, D.Sc.LOND.
Fellow of University College.

"*. . . Fresh work must be undertaken and fresh minds enlisted in the pursuit. There is no reason why victory should not be achieved, given money, imagination and patience. The first of these essential munitions of war cannot be supplied by the soldiers themselves; and the second is a rare and often elusive gift. It is by far the most difficult to secure, yet without it no success will be won.*" (*From the "Times," June 1st,* 1922.)

"*We are wondering and are the subjects of curiosity and inquisitiveness. . . . . occasionally curiosity leads to creative thought, alters and broadens our views and the views of others. Some of the greatest advances of modern science have had their origin in simple observations called into life by reflection and curiosity.*"

(*Sir Robert Firth, "Fragments," XXXIII, April,* 1923, *p.* 274.)

REASONED imagination based upon considered observation: that is what I think is needed to-day in the study of many diseases of whose mode of causation we are still ignorant, in which we have to deal with a new factor, as yet invisible and undemonstrable, manifest only by its effects.

The necessity for a comprehensive knowledge of the biology of tissue-cells, if the cancer problem is to be successfully attacked, is now generally recognized. By cell-biology I mean habits, mode of life and especially of nutrition. It is essential to remember that the tissue-cells are individual units—specialized homologues of unicellular animals. There is, therefore, no *a priori* reason to think that tissue-cells are incapable of exercising the

elemental functions of animal cells, and in particular that of the ingestion and digestion of "solid," organized material, this holozoic character being one of the principal ones which distinguish typical animals from typical plants. I have been led to consider tissue-cells from this aspect, with the result that I regard this factor as of very great importance for physiology and pathology, and one which stands in immediate relation with the question of the causation of several diseases of hitherto unknown ætiology, including malignancy.

I will first outline, in a more ordered sequence than it has gradually developed, my general conception.

The Theory of Hæmetaboly.

Many types of tissue-cell are accustomed normally to digest, or metabolize blood-elements, especially the red corpuscles, or erythroplastids. This function of blood-digestion is called *hæmetaboly*. It may be preceded by actual ingestion (*hæmatophagy*) of the corpuscles or cells (e.g., leucocytes), or it may take place extracellularly.

Unlike what obtains in single-celled animals (Protozoa), the products of hæmetaboly in the case of the individual cell-units of tissues are not, in general, assimilated mainly for the purpose of the growth and multiplication of the cells, but are utilized—as a rule and very largely so—in the production of various substances coming in the category of "secretions" or "excretions," for the welfare of the body as a whole, of which the tissue-cells are dependent and co-ordinated members. Indeed, various occurrences or changes are met with in the cell-history of various types, which constitute such unusual and remarkable phenomena, regarding them from the standpoint of the behaviour of a free, single-cell individual that they appear to be of the nature of specially developed adaptations, tending to limit the multiplication of such cells and prevent them from an excess of proliferation, in relation to those of other tissues, which would otherwise result from the complete assimilation, for their own use, of this organized nutriment.

In this blood-digestion, another factor, an enzyme or ferment, of specific character for specific types of hæmetaboly, must inevitably be concerned.

In various diseases, affecting especially certain tissues, the normal hæmetabolic function of the particular type of tissue-cell becomes altered and unsuccessful, and various bodies or granules, of very different form, are produced instead, as a result of this abnormal hæmetaboly. These characteristic inclusions are met with so constantly that they are regarded respectively as diagnostic features of the different diseases. As these diseases are all "virus-diseases," in which, so far, no indubitable micro-organism has been established as the cause, it is reasonable to consider (in view of the Twort-d'Herelle phenomenon) that the active, infective

principle of such viruses is a pathogenic enzyme, which acts by inducing the particular type of pathological hæmetaboly associated with the disease. Among such diseases are the various exanthemata, hydrophobia, typhus fever, and other infectious blood-fevers, etc.; probably, also, from the recent work of da Fano and of Levaditi, Harvier and Nicolau, *encephalitis lethargica*. In such diseases, the ultimate breakdown of the cells particularly affected, especially those containing included and altered corpuscles (or cells) is probably inevitable, when more bodies or granules, resulting from the karyolysis, will be produced.

In the case of malignant tumours, on the other hand, something quite different occurs. In its inception, malignancy is, rather, a biological reaction than a pathological process. The cancer-cells may be regarded as recuperated cells, which have acquired a fresh (if spurious) lease of vital activity. The disease results from the effects, both upon the body politic and on themselves, of their excessive and unrestrained multiplication and spread. And the essential factor in the causation of this malignant condition is the independent re-acquirement, by certain individual cells, of the capacity to assimilate the products of hæmetaboly entirely for their own use, instead of performing their normal bodily function in this respect; in other words, they have reverted to the condition of free, single cells. The many variable factors, intrinsic or extrinsic (e.g., long continued or excessive functional activity, or chronic irritation or intoxication, respectively), any one of which may serve as an exciting or inducing agent, can only be held to be accessory, in the sense that they are predisposing. Because (*a*) other cells, of the same type and in the same situation, do not become malignant in character; and (*b*) any of these factors may be in operation without malignancy necessarily resulting at all, as a natural consequence. Therefore it follows that the fundamental cause — the only "constant"—is a profound change in the life of the cell itself, it may be of even a single cell or cell-line, or at most, of the cells in a minute area. This *causa causans* lies hidden in the secret of the meaning of vitality; and it may be a very long time before this can be revealed, let alone controlled. But its *chief expression* is manifest in the production of some enzyme which can thus completely digest, for assimilation by the cell, organized material; *and this working cause is the practical feature which has to be combated.*

Such is my thesis: and I ask any *biolcgist* to say whether there is anything contradicted by known facts, inherently unreasonable or even improbable about it. While I should be the first to admit that there is a long road to travel before this view can be conclusively established in its entirety, nevertheless, I have already a substantial body of evidence in various directions, in support of certain parts of it (*vide* Woodcock, [10—13]). The farther I go, the more I obtain; and the more I obtain, the more cumulative is the effect. I do not say, of course, that every point and particular will be proved exactly right! But I firmly believe the

time will come when it will be recognized that this generalization rests upon a broad basis of truth; and if further progress in the direction of finding out the nature of the diseases to which I have alluded is desired, this question of hæmetaboly will *have* to be seriously considered, with all that it implies, and, moreover, tested along experimental lines by those who are able to do so, e.g., biochemists, in order that the foundation it provides may be built upon.

This theory of hæmetaboly, in the definite shape it has now assumed, is the outcome of nearly three years' observation and thought, and in gratitude I desire to dedicate my thesis to my mother.

Normal Hæmetaboly.

Here, I can only deal with the subject of normal hæmetaboly in its bearing upon malignant growths.

In the first place, I regard the presence of *iron as the central fact of the matter*; I think the iron is a *great source of danger to the cell*, from the point of view of its co-ordination with its fellow members in harmonious working. Growth and multiplication cannot take place without increase (*inter alia*) of the nuclear material, including the chromatin. Increase of the chromatin cannot take place without an additional supply of iron. This is a truism, but one which cannot be too greatly emphasized. On the other hand, given a supply of iron in an assimilable form, the cell will use it to form additional chromatin, this in turn leading eventually to cell division, *unless the metabolic activity of the cell is modified and regulated in a particular manner*. The vascular tissue, including the blood, is that which above all others makes use of the iron taken in by the body; and this is the tissue, the "free" tissue, in which, above all others, active multiplication is continually taking place.

It follows, therefore, that if a cell ingests and digests iron-containing material, such as hæmoglobin or chromatin (of cell-nuclei), we have every reason to expect the end-result to be seen in an increased rate of cell-division, unless something else happens. Now, let us take first the case of the ordinary macrophages, large mononuclear cells of endothelial type. What do we find here? These cells are *admittedly* "phagocytes" i.e., they ingest and *digest* blood elements of all kinds. Digest: that is the important point. It is remarkable that no one seems ever to have paid any attention to the effect of this digestion of organized material on the hæmatophage itself. Everyone seems to have been entirely satisfied with the thought that the "phagocyted" material was destroyed and finished with! A protozoologist, accustomed to consider the holozoic mode of nutrition of animal cells, inevitably thinks of the benefit of this food to the cell. A large mononuclear cell (or so-called "transitional") which begins this hæmatophagic mode of behaviour and digests this food, grows in size, and its nuclear material increases greatly in quantity,

mainly, of course, because of the iron which it is able to assimilate. Eventually, it becomes a megakaryocyte, that is to say, a *giant cell.* The nucleus of such a cell is relatively enormous and often extremely complex in appearance, or it may be subdivided into several nuclei.

It is interesting to remember that only in certain hæmopoietic organs or glands do we find these cells, where the large mononuclears are engaged in "phagocytosis." In the normal condition, we never see hæmatophagy in the general circulation. It looks as if there were either some influence inhibiting this behaviour on the part of the macrophages in the blood-stream, or else some influence exciting it, in the organs where it occurs. As the large mononuclears grow into giant-cells, they gradually become too large for the capillaries and are confined to the situation in which they develop.

Now, by all analogy with the Protozoa—and these cells are essentially Amœbæ—we ought to find active multiplication and a great increase in number; indeed, we might expect what would really amount to a malignant condition of this particular type of blood-tissue. *Instead* of this, we find these cells are specialized in a particular direction. (I do not mean to say that there is no multiplication at all; there is, but it is relatively very slight in amount and among the young forms, except, of course, when there has been disturbance of the hæmopoietic system.) The cells are repeatedly liberating portions of their *cytoplasm only,* in the form of platelet-cytoplasm, giving rise to platelets. The cells themselves, when they have attained a huge size, ultimately disintegrate completely. This view of the origin of platelets is universally accepted in America, following the work of many observers, e.g., Wright, Downey, Jordan [6] and others: and from my own observations, I have no doubt about its truth. I consider that the great majority of the platelets are formed in this manner, though not necessarily all. The platelets are only fragile cell-remains, not living cells, and probably, at times, may be produced by the "free" lysis of the nuclei of the immature reds, or of the corpuscles themselves. But I am afraid that I cannot consider that they represent an independent, specialized cell-line: I think, and so does Jordan (loc. cit.), that they are only functionally analogous with, and not true homologues of, the thrombocytes. The characteristic platelet-granules represent the inassimilable remains of the digestion of the blood-elements—be they red corpuscles, free nuclei, or leucocytes—by these macrophages. In any protozoan, feeding in a holozoic manner, there are generally fæcal remains, which are at length ejected; it is probably not often that a cell is able to assimilate *in toto* and completely incorporate in its protoplasm, the products of the digestion of organized material; though, at times, certain tissue-cells appear to be able to do so—at least no "solid" inassimilable residue appears to be produced.

There is another very interesting case of hæmatophagy on the part of mesoblastic cells, to which I may refer, though I have not yet myself been able to study it. This is the known occurrence of "phagocytosis" by the

endothelial Kupffer-cells, in the liver. These cells do not (at any rate, normally) become giant-cells. Why is this? These cells, unlike the macrophages of the type above considered, are known to produce pigment, as a result of this blood-digestion. And I think this pigment will contain the iron of the hæmoglobin, which has thus been, as it were, excreted and not used to build up chromatin.[1]

I think this fact of the occurrence of hæmatophagy and hæmetaboly on the part of macrophages has a very great *a priori* significance in relation to my general view. Here we have mesoblastic tissue-cells, now entirely separated from the hypoblast—the essentially nutritive layer—still retaining this ancestral mode of behaviour. Why, therefore, should not various types of tissue-cell arising from other embryonic layers also have retained it?

Taking first the hypoblast (endoderm), both Reichenow and I have shown that, in the case of certain blood-sucking arthropods, the digestion of their food (which happens to be blood in their case) is intracellular; i.e., the blood-corpuscles (or cells) are first ingested and then digested by the cells of the alimentary tract. The important point, in the present connexion, is not that it is their food which is so digested, but rather that the cells are *still capable* of this mode of behaviour. And we have thus added to the instances already made known by Metchnikoff in the lower Metazoa.

Again, in cells of hypoblastic origin now entirely separate from the alimentary canal, we have the important case of the hepatic epithelium. It is indubitable that red corpuscles normally occur inside the liver-cells (Browicz, and Herring and Sutherland-Simpson, and I may add that I have myself observed them in any number). These corpuscles are undergoing digestion in some specific manner, which I have not yet myself studied. But the important point is, what are the cells doing with the iron? Temporarily, at any rate, the cell appears to retain and incorporate the iron. Now there is one observation which, I think, has very great significance in this connexion. As is well known, many, often most, of the hepatic cells have two nuclei. Reinke [8] has found that these two arise from the direct (amitotic) division of one, as this increases in size (cf. the megakaryocytes). Very frequently Reinke found that one of these nuclei *disintegrates* and all traces of it ultimately disappear, i.e., the quantity of chromatin is again halved! And, on the contrary, he did *not* find cell-division following this nuclear division.

Another endodermic instance is that of the epithelium of the thyroid gland. Here too, the cells exercise a hæmetabolic function, but in this case it is very largely extracellular, the enzyme being secreted into the lumen of the acinus, where it metabolizes the blood-elements, mainly the

[1] Indeed Kupffer himself, in his original paper, stated that he had found this pigment to be iron-containing, in the stellate cells of horses.

corpuscles, into colloid. The cells themselves derive no immediate and special benefit from their exercise of this function. I may add that my account of the formation of the colloid has recently been in a measure corroborated by Parhon and Dérévici [7], working along semi-experimental lines.

Doubtless, there are many other cases among glandular epithelia of hypoblastic origin, where the "secretion" is formed, at any rate in part, as a result of hæmetaboly.

We now come to the important epiblastic (ectodermic) epithelium. There are already two cases in which it can be said with some confidence that hæmetaboly occurs. The first is that of the formation of pigment. In an interesting and suggestive article on the possibility of a pigmentary origin of cancer, Sir George Beatson recently wrote [2]: "Of the endogenous pigments not derived from hæmoglobin, the most important are the melanins." I am afraid this statement is almost certainly incorrect. I have indicated my own reasons for considering that melanin pigment is a product of normal hæmatophagy and hæmetaboly on the part of epithelial cells (e.g., of the skin) basing them on the definite observation of red corpuscles inside the cells and on a review of the known work of various authors. And, in a paper published about the same time, J. R. Fulton, in a most useful analysis of animal chlorophyll in relation to hæmoglobin and other animal pigments [5], also concluded that there is both biological and chemical evidence in favour of this view.[1]

As, however, I had not then seen an interesting paper by Acton [1], on melanotic growths, some further reference to this instance is necessary. Acton concludes that the only cells concerned with the production of melanin-pigment are mesoblastic in origin; and, also, that melanin is an iron-free pigment formed by the action of the enzyme, tyrosinase. As regards the first of these much-debated points, both the weight of the evidence furnished by other workers and my own observations lead me to

---

[1] Fulton [5] mentions that Halliburton, in his treatise, points out that the use of hydrochloric acid in making the test tends to remove the iron. And I have myself just had an illustration of this, in dealing with the pigmentiferous excreta of the normal louse. All this pigmentiferous residue contains the iron of the great bulk (not quite all) of the hæmoglobin taken in; this is a most interesting point, showing that this huge quantity of iron is *not* used by the cells (cf. also the pigment-formation in the intracellular blood-digestion in the case of mites). But unless the ferrocyanide-HCl mixture is extremely weak in the latter constituent, the pigment-grains are dissolved and all the iron dissipated when the test fails. [I may just take this opportunity of adding that I have found "Rickettsia" bodies of regular occurrence, in small numbers and usually in clumps, in the excreta of normal lice. And for the most part, these are produced by a further alteration of this unused residue of the hæmoglobin, in that, most probably by the action of the auto-cytolytic ferment of desquamated cells, the pigment-grains are "broken down" further. They lose their iron constituent and then the ultimate proteid fraction left takes up the Giemsa-stain and appears as "Rickettsia" bodies, in one form or another. I hope to publish a full account of this shortly.]

think that Acton's view is undoubtedly mistaken. This author does not appear to have considered the excellent accounts given by Dyson [4a] and Jordan (6a), the conclusion of both of whom is that the manufacture of melanin-pigment is a normal function of epidermal cell-metabolism. And, as Jordan says, there is no reason to doubt that both epidermal and dermal cells can produce their own pigment-granules; both types of cells owe their pigmented condition to the same underlying cause, which is in some way related to the blood as a source of nutrition or supply.

I have recently examined sections of black patches of skin from the mammary area of a guinea-pig, and the appearances found are precisely like those shown by Jordan and by certain of the earlier workers, to whom I referred previously. Nearly all the pigment is actually in, and being formed by, the epidermal cells; in this particular case, scarcely any pigment formation is occurring in the cutis. Hæmoglobin-"vacuoles,"[1] resulting from the ingestion of corpuscles, are plentiful; here and there a leucocyte also is seen inside a cell. And around these "vacuoles" are, very frequently, numerous pigment-grains, the condition being very similar indeed to that which Miss Lodge and I described in the case of the blood-eating Ciliate, *Hæmatophagus* [14].

As regards the question of the iron, I agree with Acton that the melanin of the epidermis does not contain iron; and this is in accordance with the findings of several workers. It must be pointed out, however, that this does not mean that such pigments never contain iron. Different melanins vary considerably in their constitution, and of this as shown by various chemical analyses, I think there can be little doubt. It is especially likely that pigment formed by certain types of connective-tissue cell possesses iron, and this point is of importance in connexion with melanotic sarcoma. What becomes, then, of the iron of the ingested hæmoglobin, in the case of epidermal cells? I find that, although the pigment remains unchanged in colour, the cytoplasm of the cells becomes distinctly blue; the colour is deep in the basal layers, gradually becoming paler in the more superficial ones. And there is a sharp line of demarcation shown between epidermis and dermis, which latter, except for the nuclei of scattered cells, remains quite colourless. A very interesting point is that in the *stratum granulosum*, although the cytoplasm of these cells is only faintly blue, nevertheless the small masses and granules which it contains are strong blue and stand out sharply.

I think, therefore, that the explanation of this condition is as follows: The iron of the hæmoglobin is not "excreted" in the pigment, in this case, but is incorporated in the cytoplasm. It is, at any rate as regards the bulk of it, *not* assimilated by the nucleus, with the consequent result of active general proliferation, but remains in the cytoplasm,

[1] To avoid repetition, fuller discussion of these is reserved until their occurrence in cancer-cells is considered (*vide* below, p. 254).

gradually becoming accumulated in characteristic little bodies occurring in the cells of the granular layer. It would seem that, even given the presence of available iron in the cytoplasm, some other factor is still necessary before it can be utilized in the formation of chromatin. Now it is generally considered (cf. Fürth, Jordan) that iron-free melanin-pigment results from the action of a nuclear ferment (tyrosinase) upon a chromogenic compound (e.g., tyrosin, or like body). This compound itself probably results as an early stage in the alteration of the globin-portion of the hæmoglobin.[1] It may be, therefore, that such a substance, which may be of the nature of an "auxetic" (i.e., inducing "growth" and reproduction, Ross), is also essential for the elaboration of chromatin for nuclear increase; hence, to the extent that such substance is modified by the action of the tyrosinase, the cell-nucleus may be unable to utilize the iron.

Another very interesting consideration bearing on this question, has occurred to me, namely, the fact that there is far greater production of pigment in races accustomed to tropical sunlight. Hæmoglobin is known to be a compound closely related chemically to chlorophyll; and further, it has a very active absorptive capacity for ultra-violet light. It is quite likely, therefore, that sunlight has an important share in the work of metabolizing red corpuscles ingested by the ordinary epidermal cells and that there is some photo-chemical action comparable with that taking place in green plants, the part played by the erythroplastids corresponding with that performed by the chloroplastids in the latter case. It may be that, as regards the general epidermis, the assistance of light energy is now in many cases necessary, either to produce or "activate" an enzyme requisite for this normal hæmetabolic function on the part of this particular type of tissue cell.

Secondly, there is the instance which I am at present engaged in studying, namely, hæmetaboly in connexion with the mammary gland and the formation of milk. Although it will be some time before this work is ready for publication, it throws such a flood of light on the whole question that I will briefly indicate the conclusions to which my observations have already led me. The great and rapid increase in growth of the epithelium during the later stages of pregnancy is accompanied by hæmato-

---

[1] Samuely (Hofmeister's Beitr. 2, 1902, p. 356) says that it is necessary to reckon with the possibility, where circumstances point strongly to pigment-formation from hæmoglobin, that not the small percentage of hæmatin is the parent-substance of iron-free pigment, but the twenty-fold amount of globin present. That globin possesses the ability to form melanin-like pigments follows readily from the presence therein of colour-forming groups, which easily produce pigment, e.g., tyrosin, skatol [and, it may be added, from the work of Hunter and Borsook, tryptophane]. Lastly, there is the possibility that the chromogen groups of albumin [i.e., in this connexion, globin] and of hæmatin, are ultimately identical, so that according to circumstances, at one time hæmatin-pigment, at another time melanin-pigment, can be formed. I think these remarks of Samuely, which I have translated as well as I can, are extremely important.

phagy.[1] And from the appearance of the large, richly chromatinic nuclei, the absence of pigment or other signs of residual products, I consider that the cells are assimilating for themselves the hæmoglobin, apparently completely, using the iron to form abundant chromatin, this in turn leading to cell-division.

In the lumen of many of the young acini, hæmoglobin is present in quantity, just as I found it to be in the lumina of the thyroid acini. As to how it gets there in the earlier stages, I wish, at present, to express my view with a slight reservation, just because in dealing with isolated nuclei it is sometimes difficult to be sure that such are indeed epithelial ones, which vary very greatly. In the case of the nuclei of the thyroid-epithelium, this difficulty did not arise, because of the definite and uniform appearance they presented. There, I have found, not only in an adenoma, but also (since my paper was published) in the normal gland, that the nuclei may pass inwards and come into direct relation with a minute capillary, and then give rise by multiplication to a wall of epithelium around the latter, thus forming a new, young acinus. Now, what the epithelium of one vascular gland does, there is no reason to think that of another is incapable of doing, and I have distinct evidence that a similar process may take place in the formation of fresh acini, in the extending mammary gland. It will be noted that I have had regard to nuclei, rather than to cells. The accompaniment of a certain amount of cell-cytoplasm is, of course, implied; but, especially in this latter case, there may be so little apparent cytoplasm that the cell-nucleus itself is evidently of paramount importance in this behaviour. On this view, therefore, the lumen of a small acinus is, or has been (for it may become cut off), in direct communication with the vascular system.

At any rate, at a later stage when the gland is functioning, the blood can be forced *en masse* into the lumen, most probably by diapedesis, just as in the case of large thyroid acini. And, if my experience as a microscopist counts for anything, I say without hesitation that the only conclusion which can be drawn from what is to be observed is that altered hæmoglobin in the lumen, which in this case has the form of "colostrum" instead of "colloid," becomes in part further transformed into milk-fat.

But this is only half of the matter. When the gland is fully developed, *the character of the hæmetaboly is changed.* This is a most interesting and significant point. The production of the requisite blood-digestive enzyme, for the "growth" of the epithelium was most probably incited from "outside," by some "hormone" formed in connexion with the developmental activity, which ceases to be produced after the time of birth.[2] Hence, no

[1] As an instructive item of experimental evidence of significance in this connexion, it may be mentioned that Loeb found that the *epithelial* cells of *regenerating* mammalian skin ingest red blood-corpuscles. Now, why should they do this?

[2] O'Donoghue has found that the *corpus luteum* produces a hormone which incites growth of the mammary gland.

longer are the cells living on the blood, assimilating it solely for their own use. Hæmoglobin is still being taken in, and the cytoplasm contains iron; but the proteid of the hæmoglobin is being metabolized into fat-droplets, and the nuclei are not using the iron, at any rate in the manner and to the extent they were doing before. Instead, what do we find? Portions of the cytoplasm and even of the nuclear material are cast off, along with the fat-globules, into the lumen of the acinus, where they, too, "break down" and are metabolized into milk-constituents (cf. also the similar condition met with in the case of colloid-formation). Nature wastes nothing that can be utilized!

To summarize: all the above observations in regard to normal hæmetaboly indicate clearly, in my opinion, that the exercise of this function is accompanied by special adaptations of one kind or another, on the part of the tissue-cells, enabling them to metabolize this iron-containing material *without cell-division necessarily ensuing as a consequence.* The main point to be emphasized is that normal hæmetaboly is *not*, in general, for the benefit of the cells themselves, but for the welfare of the body as a whole; its utilization for their own "growth," or multiplication, is most stringently controlled. And normal hæmetaboly is, I believe, the key to the understanding of the malignant condition.

MALIGNANT TUMOURS.

I hope we are now in a position to realize that the cardinal feature in Dr. Charles Creighton's view of malignancy is eminently reasonable and understandable. "The tissue-cells become cancer-cells by feeding on the reduced" (i.e., digested) "substance of the blood." That is the essence of the matter, from the practical point of view. I first saw Creighton's book "Some Conclusions on Cancer" at a time when I was studying the megakaryocytes and feeling profoundly impressed with these giant cells and the potentialities latent in them; and I immediately realized that "blood-eating" might well be a vastly more important factor in malignancy than had hitherto been thought to be the case. Most unfortunately, Creighton took the view that cells of the vascular tissue itself thus produced the cancer.[1] But this must not be allowed to militate against a recognition of the great step forward which he took in elucidating the essential nature of this disease. The more I study his book and note its wealth of facts and observations, both by himself and by others, all pointing unmistakably to the occurrence of blood-digestion, both normally and pathologically, the more I am amazed that no one has taken the trouble to winnow the good, sound grain from the chaff. No investigator can be altogether right in his conclusions; but, surely, if no one threshed out the wheat, we should be very badly off! Adami was the first, I think, to point out the right direction in which to travel, when he ascribed malignant disease to an alteration

[1] In true endotheliomata, it will be, of course, cells of this tissue which are concerned.

in the activities of the cell whereby function, i.e., its specialized function, becomes lost and only the power of growth remains. Creighton and I have developed this thesis, by trying to show what is the character of this profound alteration in the cell-metabolism.

In the light of the occurrence of normal hæmetaboly, it is seen that this blood-digestion is no entirely new development on the part of tissue-cells, something originating *de novo*, which bears no relation to the normal metabolism. Indeed, in the increase of the mammary gland, there is something which can be regarded as actually corresponding to neoplastic behaviour, with the all-important distinction that it is regulated, not merely from "outside" but also from within, because the cell-equilibrium is not disturbed. And probably other cell-types may on occasion behave similarly, e.g., placental tissue, as Creighton has pointed out. It by no means follows, even in these cases, that the hæmetaboly is of exactly the same character as in malignancy, bearing in mind the enormous variety of different ways in which red corpuscles can be metabolized by cells.

The main difference in a cancer-cell is that this has become able to produce of itself an all-powerful digestive enzyme, independently of outside influence or control; and this inherent capacity is transmitted to its descendants, in cell-division. It will be readily understood how the elemental vital activities can be amazingly stimulated, granted the acquisition of this power. And, in the early stages of a malignant growth, the cells are not unhealthy or feeble. They tend to eschew their normal specific function in relation to the body, as can indeed be readily understood on my view of normal hæmetaboly; they are making other use of the blood. But, regarded as living individuals, they are full of vigour, as expressed by their growth and multiplication. It is only in the later stages, as the cells become cut off from the vascular supply—now more than ever essential—and surrounded by the concentrated toxic products of their own metabolism, that they degenerate and die.

The point may be raised that this view takes no account of the disruption of the "tissue-tension." Why do the cancer-cells pass inwards? I think far too much stress has been laid upon this question, as an "external" cause. Certainly from the case of the thyroid gland, and in all probability from that of the mammary gland also, my indications are against the view of a rigid delimitation between cell-layers, and a constantly fixed situation of the epithelial cells. I think the cancer-cells pass inwards because in this direction they will meet with blood-elements, to which they may now be chemotactically attracted. [1]

Similarly as regards possible bodily factors which have been adduced in a causative sense, for instance, altered conditions of the blood, such as the presence of "auxetics," the absence of inhibitory or other agents, these are

---

[1] Sir Clifford Allbutt (*Lancet*, 1920, ii., p. 1), has asked, "May the dive inwards of epithelial cells in cancer be due to some inversion of chemotaxis?"

rather to be looked upon as results of the metabolic activities of the growth and not as its cause. In all such cases, we are up against the fact that only *certain* cells of a particular tissue, gland or organ, take on this property of malignancy. The ultimate cause must be, beyond doubt, I think, inherent in such cells themselves.[1] One may look upon it as a biological response or reaction on the part of "weakly" cells, which have passed into some physiological state of depression or exhaustion, in which the cell-equilibrium becomes upset—a kind of "cell-madness," if I may venture to use the term. But as I said at first, this is only a cloak to hide our ignorance of the nature of life and individuality.

I do not think any special reference to the parasitic view is necessary. Neither do I consider that it is at all necessary to postulate the presence of "embryonic rests" in order to account for the origin of malignant growths (apart, of course, from teratomata).

The Occurrence of "Blood-Eating" in Malignancy.

That cancer-cells may "phagocyte" not only corpuscles and other blood-elements (leucocytes) but also eat one another is, I understand, *recognized*, though, before Dr. Creighton, no one seems to have given this remarkable fact the attention it deserves. And, of course, it will have to be ascertained that such is of regular occurrence. But a word of caution is here necessary. It must not be thought that all the cancer-cells will always be engaged in feeding! Far from it. At any one time, or in any particular zone, only few may be found so doing. After a "meal" there will be a period of assimilation, nuclear increase and multiplication—for some generations—before that cell-line takes another "solid" meal. All the time, of course, the cells are also able to obtain their customary, pre-digested nutriment from the plasma. Even among the admittedly normal "phagocytes," many large mononuclears and megakaryocytes in the bone-marrow or spleen contain no ingested blood-elements, recognizable as such, at the time of examination, though they often have the inassimilable remains of such digestion, the platelet-granules, in their cytoplasm. And at periods, or in little areas where the cancer-cells most nearly present their typical tissue-characters, we may well find hæmatophagy in abeyance. But once the cells have acquired this capacity, it will be inherent in all their descendants, even though sometimes it may remain latent.

On the other hand, at times or in areas where this mode of behaviour is active, we shall probably find the cells least resembling in character the type from which they have originated. Most if not all the cancer-"parasites" which have been described are undoubtedly remains of hæmoglobin, cell-nuclei, etc., in an early stage of digestion. But when the digestion is

---

[1] Murray also considers that "the malignant transformation is a positive change in cells previously healthy . . . and is not due to a failure of control by the body-fluids or neighbouring cells" (*Medical Press*, April 5th, 1922).

completed, there is *nothing left visible* of the digested material, *unlike* what obtains in "virus-diseases" of epiblastic, epithelial cells, in which the hæmetaboly is unsuccessful and incomplete, when we have Negri-bodies, Guarnieri-bodies and so on, as unmistakable witnesses of its occurrence. The *results* of completely successful assimilation are manifest, however, in large, irregular nuclei, rich in chromatin and great cells, sometimes multinucleate—in fact, *in the typical characters of giant-cells*. Creighton has rightly laid emphasis on this point. The all-important difference is that, instead of cutting off portions of cytoplasm only, as is the ordered function of megakaryocytes, cancer-cells enter upon a period of rapid, it may be irregular, division—which, in the circumstances, is naturally to be expected!

When I came to examine malignant growths, I had no difficulty in observing the occurrence of hæmatophagy, at times on a surprising scale. Of course, I have not yet studied many cancers but as I have found it in all so far examined, I think, in view of the urgent importance of the subject, it is well worth while to give some instances now, in order that others may realize for what to look.

I desire to express my grateful thanks to Dr. D. J. Reid, for kindly taking the accompanying photomicrographs for me. They represent fields of three malignant growths, namely, a very young epithelioma of the gum, from a section kindly given me by Dr. Reid; a very early epithelioma of the lip, from a section kindly lent me by Dr. Leitch, of the Cancer Hospital; and an early (though not quite so young as in the preceding cases) carcinoma of the tongue, from preparations made by Dr. J. D. Thomson and myself.

Before considering these, however, it must be noted that there are two premisses which it is essential to bear in mind in considering hæmetaboly on the part of tissue-cells. In my paper on the formation of the colloid I dwelt upon these two points, but I think it is advisable to emphasize them again. One is that hæmoglobin, in the early stage of digestion, becomes bleached, i.e., colourless; hence an ingested corpuscle may appear as a "vacuole" or space. The other is that corpuscles undergoing digestion (or lysis) may "run together," when masses or globules of hæmoglobin (or "vacuoles") larger than the size of a single corpuscle, may result. Both these premisses are founded on known facts, viz., experimental observations made by the renowned Metchnikoff.

For my present purpose, the first of these is all-important: once this is recognized, the second presents no difficulty. I briefly alluded to it in my first paper, when dealing with "phagocytosis" on the part of the macrophages. As, however, I was there more concerned with the subsequent appearance of the granular, red-staining material (the precursor of the platelet-granules), I give here in fig. 1 two instances of a colourless hæmoglobin-"vacuole" in a macrophage. The blood-smear from which this photograph was taken was kindly lent me by Dr. Bedson; it was from a

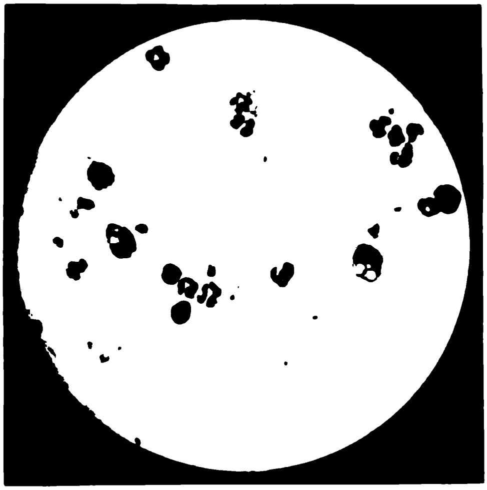


FIG. 1.

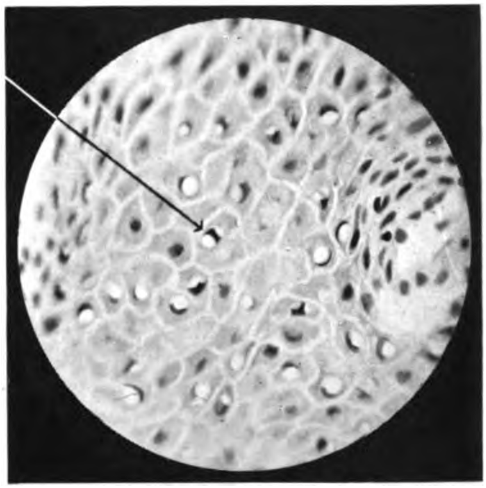


FIG. 2.

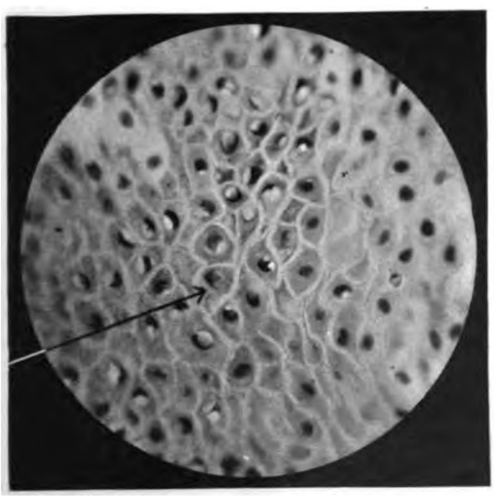


FIG. 3.

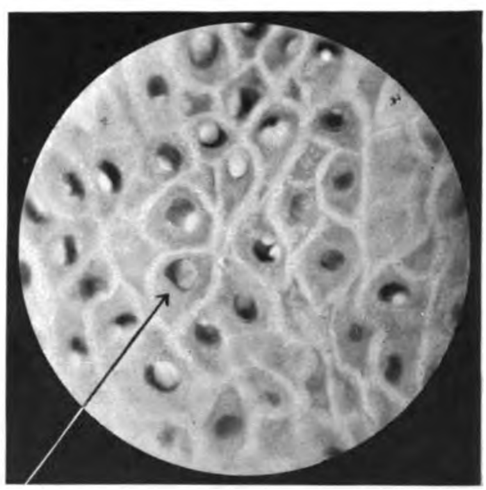


FIG. 4.

To illustrate "A Modification of Dr. Charles Creighton's View of Malignant Growths," by H. M. WOODCOCK, D.Sc.Lond.

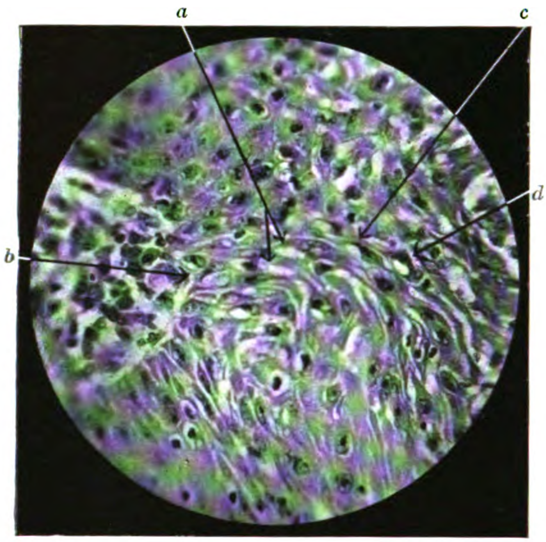


FIG. 5.

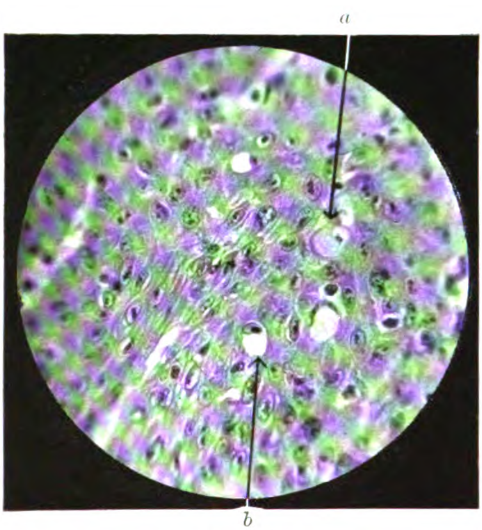


FIG. 6.

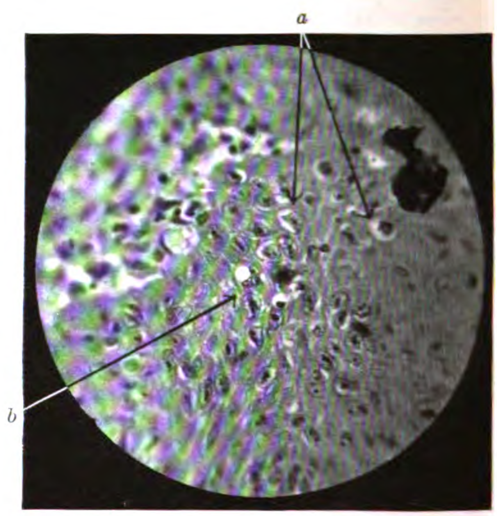


FIG. 7.

To illustrate "A Modification of Dr. Charles Creighton's View of Malignant Growths," by H. M. WOODCOCK, D.Sc.Lond.

guinea-pig in which marked hæmatophagy had been induced.[1] Two macrophages are seen, each containing a recently ingested corpuscle, still staining like the free ones around, and also another which has become completely bleached and appears as a "vacuole." I may add that Dr. Bedson entirely agrees with me upon this point.

Now, *these two conditions occur very frequently in the early stage of hæmetaboly by tissue cells* (cf. my work on the colloid.) And in the two very young growths to which I have alluded, I have no hesitation in saying that they are presented by the cells of the down or in-growing epithelium to a marked degree. Figs. 2 to 4 are from the epithelioma of the gum. The central part of figs. 2 and 3 shows the epithelial cells in close relation with connective-tissue areas (one on either side in fig. 2, one to the upper left-hand corner in fig. 3), which the epithelium is invading. Many of the cells show the characteristic "prickles." And many of them contain ingested corpuscles, in some stage of digestion, either singly, or in small masses of two or three, which have run together. These happen to be mostly (though by no means always) in the form of pale hæmoglobin-"vacuoles."[2]

Now, it might be thought that these clear areas are merely shrinkage-spaces; due either to contraction of the nucleus during fixation or to old and naturally shrunken or degenerating nuclei.

I am confident that neither of these alternatives is the explanation of this condition for the following reasons. As regards its being an artefact, this is at once negatived by the fact that it is only shown by certain cells, especially those in the advancing area of the growth, near the connective tissue. At the right-hand side of fig. 3, for instance, the nuclei of similar epithelial cells are all of the customary appearance. Borrmann, in his account of skin carcinoma [3], figures (figs. 67 and 82) identical appearances and dismisses the idea that they are artificial for the same reason. Borrmann, however, does consider that the second alternative is the correct explanation, but this worker had not my advantage of knowing of the occurrence of hæmatophagy and hæmetaboly by tissue cells!

In the first place, it is not the cells which might reasonably be regarded as old and degenerating that show these appearances. On the contrary, they are found mainly in cells near the growing, advancing edge of the epithelium, in which situation one is bound to conclude the cells are active and healthy (cf. also the second case, below). It is extremely improbable that all these nuclei, in the earliest stage of a young cancer, are going to

[1] To produce this result one cubic centimetre of anti-whole blood-serum had been inoculated intra-peritoneally. The smear was made about seventeen hours after the inoculation.

[2] Unfortunately, the section was not counterstained ; if it had been counterstained with eosin, for instance, more of the "vacuoles" would have shown faint tints of colour. Moreover, it must be remembered that the actual contents of some of the "vacuoles," if in a more fluid condition at a certain stage, may have been dissipated in the course of making the sections.

shrivel up and degenerate! The older, quiescent cells nearer the surface do not show this condition (cf., again, the right-hand side of fig. 3). On the other hand, similar appearances are shown in relation with the cell-nuclei, in the case of *normal* epithelial cells *forming pigment* (cf. above). In these malignant growths, on the contrary, *there is not the least sign of pigment-formation in connexion with these hæmoglobin "vacuoles"*; a most significant point![1]

The nucleus is usually wrapped closely, in a crescentic form, around the included corpuscle, or little corpuscular mass. And the inner rim of such a nucleus, abutting on a "vacuole," can sometimes be seen, with a high magnification, to be thickened and stained more intensely, having probably been somewhat compressed; I have often observed this appearance in the case of large mononuclears and lymphocytes containing ingested corpuscles. Now and again a corpuscle has been ingested, one on either side of the nucleus, which is then indented on both sides (the arrow in fig. 2 points to such a case); an identical appearance is seen sometimes in the case of a lymphocyte which has ingested two corpuscles which it is metabolizing into Kurloff-bodies (cf. fig. 11 of my first paper). Lastly, here and there the contents of these "vacuoles" have a definite, though generally pale, staining tint, indicating unmistakably the presence of substance in them. Near the centre of fig. 3 (marked by the arrow) is such an instance, where the two included corpuscles, still separate, as shown by the division-border between them, have well retained the stain and appear as little homogeneous round bodies, quite distinct from the closely applied nucleus. In fig. 4 the same cell is seen at a higher magnification.[2]

I have laid stress on this case, because one could hardly obtain, I think, an earlier malignant growth to examine, and I regard it as of great importance in showing that one of the earliest manifest changes in cells assuming malignancy is their tendency to hæmatophagy.

The next case, that of the epithelioma of the lip, furnishes further corroboration of the extent to which this blood-ingestion and digestion goes on. Though still very young, this growth is not quite so early as the first. It is still everywhere connected with the superficial epithelium, and there are no internal separated areas of the growth; but the proliferated

[1] Here and there in the connective-tissue, granules of bright yellowish pigment can be seen.

[2] As I know it is somewhat difficult at first to realize this point, it may be worth while to give an illustration from the Protozoa. Thanks to a useful suggestion recently made to me by Colonel A. Alcock, *re* hæmatophagy and hæmetaboly in *Balantidium*, I looked up a paper by Comes (*Arch. Protistenk.*, xv, 1909, p. 54), on this subject. This author describes *perinuclear* vacuoles, markedly lobed in outline, which can only indicate the pale and partially digested hæmoglobin of the ingested red cells, some of which have "run together," and including, of course, the minute quantity of the requisite ferment produced by the nucleus. The author expressly notes that no liquid is taken in with the cells, i.e., the digestive vacuole is "virtual." In this case, the nucleus retains its shape unaltered.

epithelium is thicker, i.e., it extends more deeply into the underlying connective tissue, and the cells are more changed, having largely lost their characteristic form and appearance. The most striking impression gained is that *the growing cancerous epithelium is permeated and pervaded by the blood.* This is seen especially well in fig. 5, which shows a tongue or zone of active, elongated cells, advancing in the direction of the connective-tissue area on the left. In many places, between the individual cells, are rows of a few pallid corpuscles in intercellular channels (*a*). At (*b*) are two cells, abutting on the connective-tissue area, each of which contains an ingested corpuscle, the one in the left-hand cell being pallid, the other still staining with the eosin. The arrow (*c*) points to a similar condition, and immediately to the right (and, indeed, in many other places of the field) is a cell with a pallid hæmoglobin-"vacuole" (*d*), *perfectly similar in appearance to the condition prevalent in the case above considered,* and with the nucleus partially wrapped round it.

Figs. 6 and 7 show how the advancing epithelium encloses minute capillaries, which thus become completely embedded in it. The capillary wall becomes dissolved, even the endothelial nuclei seem to be digested (cf. the upper capillary in fig. 6 (*a*), where the endothelial nucleus stains faintly and seems to be on the point of disappearing). Into these channels cancer-cell nuclei penetrate, alter the corpuscles, producing the same hæmoglobin "vacuoles," and absorb this nutriment. At (*b*) in fig. 6 there is still a faint tint of colour in this area, which appears perfectly similar to that of the pale corpuscles in the vascular channel just on the left (running up from the south-west). Ultimately, these large nuclei lie bathed in a bath of blood (cf. *a*, fig. 7); I cannot express the condition better. There is often extremely little cytoplasm visible in connexion with such growing nuclei; one almost obtains the impression that the nuclei are largely independent of the cytoplasm! At any rate, the initiative is clearly with the nucleus.

Nowhere are there any signs of conspicuous "bodies," granules, "Rickettsias," or the like; the only reasonable conclusion one can come to is that these epithelial cells are living on the blood themselves, for their own use.

At first, the cancer-cells appear to engulf, or surround only red corpuscles, as in the case of the normal hæmetabolic function; but later, they acquire a taste for leucocytes, especially polymorphs, which are ingested to a predominating extent. The remaining plate-figures are from sections of the early carcinoma of the tongue, which was, however, rather further advanced than either of the other two growths; and they are chiefly to show this ingestion of polymorphs. Fig. 8 shows two finger-like processes of active cells pushing into the stroma, to the north of the field. The arrow points to a cell containing in its cytoplasm both a corpuscle and a polymorph. The dark body, just to the right, is the huge nucleus of another

cancer-cell. (The nuclei in all these figures, I should add, appear denser and more uniform because these sections were stained with Giemsa.) In the finger to the left, a cell-nucleus is seen undergoing mitosis. In fig. 9 is another rapidly growing area, in which the cells are invading and replacing the connective-tissue. To the north of the field is the commencement of a large zone practically filled with polymorphs; and, actually, in the upper part of the figure, many of the polymorphs are surrounded by, and in some cases definitely included in, the cancer-cells.

Fig. 10 shows a small lacuna or channel of this nature, containing numerous polymorphs, which is surrounded by cancerous epithelium. Unfortunately, I cannot say what, exactly, these lacunæ represent. They are not infrequent in my sections of this growth, and in some which were kindly shown me by Dr. Ledingham, of a young carcinoma of the ear, they are also common. They are more probably lymph-spaces rather than vascular channels. However this may be, the important point is that they contain blood-elements in any number; at times mostly polymorphs, at other times chiefly corpuscles. Into these blood-containing channels the cancer-cells readily pass. In this case, two large cells have invaded the lumen; the upper one possesses three distinct nuclei (to which the upper arrow points), and the lower one two, of which one is almost out of focus. The cytoplasm of these cells practically obliterates the lumen, and some of the polymorphs are definitely included in the cytoplasm. I think there can be little doubt that many of the compact, solid-looking little morulæ of cells result in this manner, from the invasion of such a channel by a few cancer-cells, which eat the blood-elements, multiply actively, and ultimately leave no indication of the lacuna. In fig. 11 is seen such a morula; ingested polymorphs are plainly visible, and the smaller arrow-head points to an included corpuscle.

Cannibalism and Cell-Nests.

As briefly indicated, cancer-cells are known, on occasion, to eat one another, i.e., they become cannibals. This is a most interesting point, because, though they can digest other forms of cells and organized material, they appear to be unable properly to digest and assimilate protoplasm of their own specific type and character. And a valuable instance of cannibalism in an *Amœba* has been recently described by Lapage [6*b*], which affords almost a perfect parallel to this mode of behaviour. In text-figs. A and B I have reproduced, by kind permission of the author, two of his figures, which show the result of a series of such performances on the part of the various amœba-individuals. The remarkable appearance shown in the first figure is to be thus explained: The amœba whose nucleus is designated by *n3*, has been first of all ingested by that one next enclosing it (*n2*), when the latter was in the free, active state. This cannibal and its victim were next engulfed by another amœba (*n1*), and finally these three have all been ingested by the large, still active individual, the *karyosome*

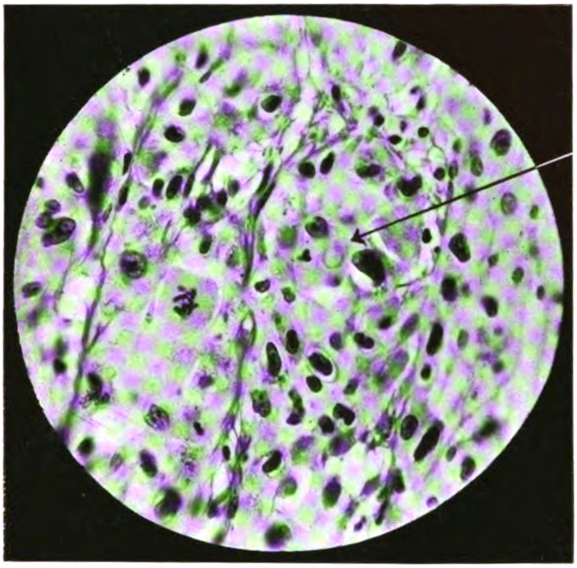


FIG. 8.

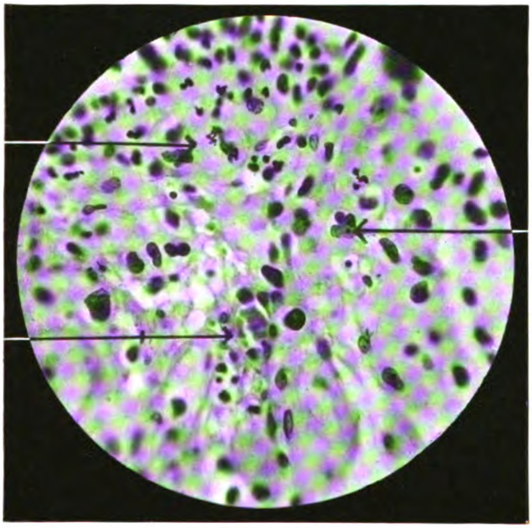


FIG. 9.

To illustrate "A Modification of Dr. Charles Creighton's View of Malignant Growths,"
by H. M. WOODCOCK, D.Sc.Lond.

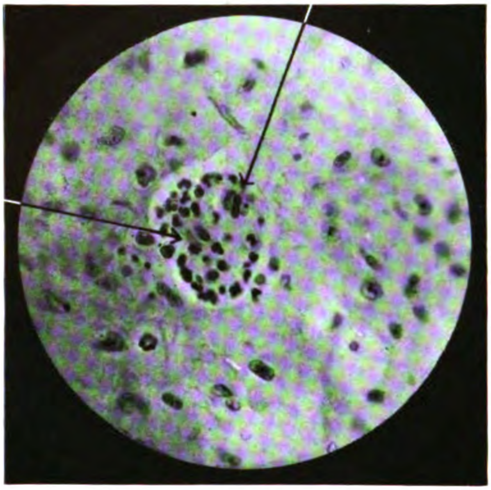


FIG. 10.

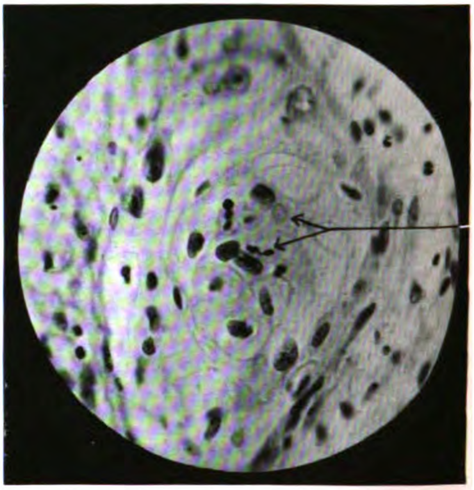


FIG. 11.

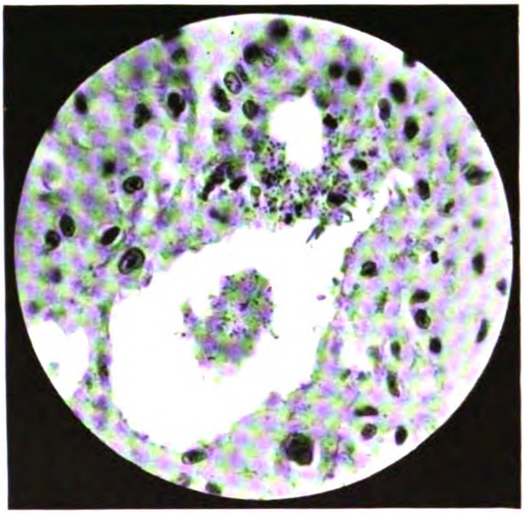


FIG. 12.

To illustrate "A Modification of Dr. Charles Creighton's View of Malignant Growths," by H. M. WOODCOCK, D.Sc.Lond.

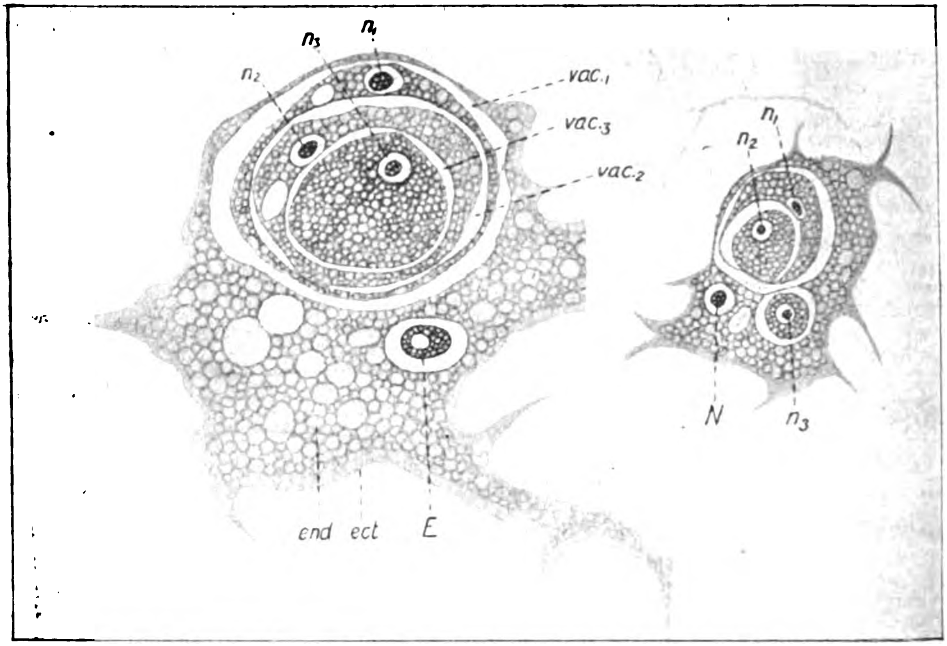
of whose vesicular nucleus is designated by *E*. (The clear zone represents the nuclear sap and is not a shrinkage space.) In text-fig. B the large, free amœba (*N*) has eaten both a cannibal and its victim (*n1* and *n2*) and also, separately, another small amœba (*n3*).

These ingested[1] amœbæ are killed and become rounded, and later, they may be partially altered or broken down. Lapage found that they were at times extruded again, in a killed or injured condition, unable to recover. This, in itself, indicates their indigestibility, and Lapage concludes that it is most probable the amœbæ are unable to digest and assimilate individuals of their own species—at least if ingested in a normal and healthy condition. It is apparent, indeed, from text-fig. A, that the first victim (*n3*) must have been ingested some time previously, since two successive acts of cannibalism have taken place; but none of the eaten individuals shows any sign of being digested. An interesting and rather important detail of difference is to be noted in this case from what occurs when tissue-cells are digesting ingested organized material. There is no indication that the nucleus becomes applied to or tends to wrap round the included material.

In the young carcinoma of the tongue, such instances of cannibalism, or attempted cannibalism, are not infrequent. Text-fig. 1 shows a large cancer-cell containing another, smaller cancer-cell, which it has engulfed, and in this case the large, richly chromatinic nucleus of the cannibal is crescentic in form and closely applied to the included material. In text-fig. 2 precisely the same condition is present as in text-fig. B. The large cancer-cell whose nucleus is indicated by *N* has ingested both a cannibal and its victim (*n1* and *n2*) and also, separately, another cell (*n3*). It will be noticed how attenuated the cytoplasm of the outer cell (*N*) is where it encloses the pair of cells (*n1* and *n2*) on the south-east side; it appears here as little more than a line. Just the same thinned-out condition is seen in the case of the amœba-cannibals in text-fig. B, especially as regards the amœba (*n1*), where it encloses the first victim (*n2*) on the south-west side, and also, though not to quite the same extent, as regards the large, free amœba, at nearly the same point. In such cases it appears as though the cannibals had only just been able completely to surround their victims.

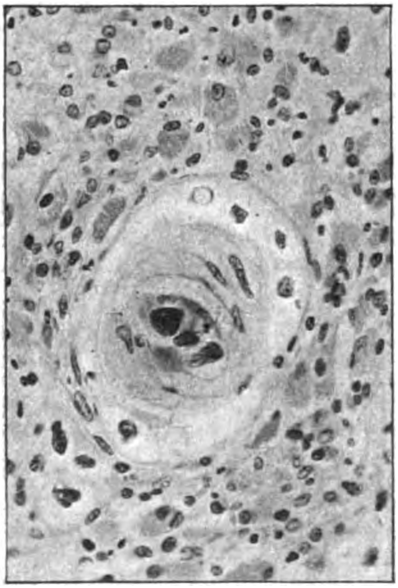
Now, in the case of cancer-cells, this process may go on to a surprising degree. But soon it becomes, rather, a case of attempted cannibalism only. After the first few instances of multiple cannibalism, as it may be termed, the cancer-cells are no longer able to surround the ever-increasing mass. Those in the immediate neighbourhood become applied as a whole closely around it, becoming greatly narrowed and extended, but forming only incomplete rings, as it were. An indication of this is seen already in fig. 2,

[1] There is no question that these are ingested amœbæ and not endogenous buds. This is shown conclusively by Lapage, who points out that many of these included individuals themselves contain diatoms and other food-material, a proof that they have been in the outer world.

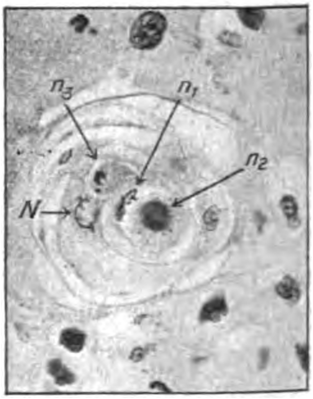


A **B**

1



3



2

Text-Figs. A and B: Illustrating cannibalism in *Amœba vespertilio* (after Lapage). A, × 900; B, × 450 (approx.). (In fig. A, a portion of a large pseudopodium on the right has been omitted, to save space). 1, 2, and 3: To show cannibalism and attempted cannibalism, leading to formation of cell-nests, in carcinoma. 1 and 2 × 500; 3 × 300. (For reference-letters, see text.) (Photos 1-3 were kindly taken by Mr. A. Dennis.)

but in a better-defined manner in text-fig. 3. Thus we get the well-known concentric "cell-nests." Multiplication of the component cells may perhaps occur to a very slight extent (e.g., possibly the two applied cells just on the right in text-fig. 2 have resulted from the division of one), but I think, in the main, multiplication plays a very small part in the formation of these nests.

Alteration of the ingested cells occurs, but my indications are that proper digestion and assimilation of this material cannot take place. In text-fig. 2 the nucleus of the first ingested cell (*n2*) has become rather dense, and the cytoplasm has peculiar granules in it. The nucleus of the separate victim (*n3*) has become fragmented. But generally the ingested cells simply alter into a more or less uniform, densely staining mass (cf. text-fig. 3). I think this alteration results in the production of some chemical substance which acts as a stimulus to the surrounding cells, inducing them to continue to try and enclose the mass in ever-widening rings. But, ultimately, the whole degenerates to form a sort of keratinized mass.

Extracellular Digestion.

It is important to note that partial digestion, at least, of the blood may take place extracellularly, the ferment being poured out of the cells. There is nothing surprising in this behaviour. In some sections of the bone-marrow of a purpuric guinea-pig, which were kindly lent me by Dr. Ledingham for the purpose of my platelet work, a particularly vigorous "phagocytic" response on the part of the megakaryocytes is seen to be occurring. Many of these contain several included eosinophil polymorphs, in one great, comprehensive "vacuole" (cf. figs. 7 and 8 of my first paper). Here, the digestion is occurring, in reality, extracellularly. Because a huge lobe of a megakaryocyte may thus enclose eight or nine cells, and even when these are surrounded they and the included plasma remain, for all intents and purposes, part of the "outside" world, the digestive ferment being poured into this "vacuole."

Now plate-fig. 12 shows a perfectly comparable condition. A large lacuna, surrounded by cancer-cells, contains blood elements in various stages of alteration. In the upper part the corpuscles have been resolved into fragments and large granules; here also are a few disorganized polymorphs. In the middle of the larger part of the space is a uniform, finely granular mass of altered hæmoglobin. I know, of course, it can be said that this is just "broken-down" blood and means nothing; it is being destroyed by autolysis and will be "absorbed." I venture to submit that it means a very great deal. I think the blood has been reduced to this condition by the action of the blood-digestive ferment secreted by the surrounding cancer-cells, and that it is being *used as pabulum* by them. Red corpuscles themselves are *not* living cell-individuals; they are (now) only plastids. That much is certain.

According to the generally accepted view that enzymes are only produced by living cells, these corpuscles *cannot* themselves, therefore, produce a ferment. I have been informed they contain catalase, but I do not think this, itself, can exert any lytic action upon them. I do not see how they can contain a lytic (digestive) ferment, because, if so, they would—being non-living—automatically undergo autolysis, in the manner that dying cells do. As I have pointed out previously, there is no evidence of such behaviour in the blood. Where masses of altered hæmoglobin, etc., resulting from the lysis of corpuscles are found (naturally), this occurrence must be due, I think, to the ferment action of neighbouring cells; though it may possibly be that the catalase assists, in a manner comparable, for example, with the action of enterokinase (cf. "Poskscrift," p. 268).

And I think, from what I have so far observed, that this extracellular hæmetaboly operates largely in sarcoma, and that there the blood-digestion is mainly extracellular rather than intracellular. In a section of a sarcoma of a foot, also kindly lent me by Dr. Leitch, this "break-down" of the blood presents, at least to my eyes, an amazing sight. Numerous large areas of blood, in all stages of disorganization and "alteration," are present into which the advancing sarcomatous cells are penetrating. I am inclined to think that more use is made of the hæmoglobin in sarcoma, and this may be why this form of malignancy tends to travel along the route of the vascular system, while carcinoma tends to follow the lymph-channels, where there are more cells.

Sir George Beatson has recently laid stress [2] on the occurrence of unusual pigment, and in increased amount, in the cells of *other tissues* in the neighbourhood of a growth, and considers that cancer may have a pigmentary cause. I think this question of pigmentation is, far more probably, a concomitant of the development of the malignant state. Its occurrence points to a stimulation by the cancerous growth of the functional metabolism of other types of normal cells, along more or less usual lines. In melanotic sarcoma, on the other hand, the malignant cells themselves may produce pigment in quantity. I think this is because, owing to the action of the powerful exo-ferment, these cells are able to digest and absorb more hæmoglobin than they actually require; hence, in addition to using sufficient iron for their own rapid nuclear increase, a surplus is "excreted" in the form of melanin-pigment.

The Possibility of Infectivity in Cancer.

The radical cancerous change in hæmetaboly is, in general, so inherent in origin that normal cells are, as a rule, in too well-balanced a state of vital equilibrium to be induced from outside to revolt. But there are one or two suggestive cases which indicate that malignant behaviour on the part of cells can be directly induced from outside. By this I mean, not merely self-inaugurated as a result of continued, artificial irritation, but on the lines of the Twort-d'Herelle phenomenon, the same digestive enzyme,

or a chemical substance probably closely akin to it, at once stimulating the production of the malignant enzyme in normal cells. Peyton Rous's transmissible fowl-sarcoma is such an instance. Rous himself said [9] that, instead of a minute parasitic organism being the infective agent, "it is conceivable that a chemical stimulant elaborated by the neoplastic cells might cause the tumour in another host, and bring about in consequence a further production of the same stimulant." A very suggestive and prophetic idea, enunciated long before the Twort-d'Herelle phenomenon was heard of! If we regard this chemical stimulant as being the blood-digestive enzyme, I think we have the right explanation of the nature of the "infective" agent in this particular type of malignant disease. Dr. Arkwright, it is interesting to note, has recently also suggested [1*a*] the possibility of the "virus" of fowl-sarcoma being of enzyme-nature. Now, does not this case then fall into line with my general view of the ferment-viruses? The all-important difference is that, in the latter, the abnormal hæmetaboly thus induced is incomplete and unsuccessful, whereas in malignancy it is only too successful.

Again, in Fiebiger's *Spiroptera*-cancer, some metabolic enzyme produced by the worm may be able to induce certain tissue-cells of the host to develop the necessary digestive enzyme which will start them on their career of unrestrained multiplication and spread.

In view of such instances, I would greatly hesitate before saying that human cancer never has, in any case, an element of infectivity about it.

It may be thought that this admission of the possible "outside" origin of the malignant enzyme conflicts rather with the sharp distinction I drew in my opening paragraphs between "virus diseases" and malignant growths. But, really, one cannot draw hard and fast distinctions in biology; lines of separation are rarely straight and unbroken. So in this case, one can only speak in general terms. The instances of "exogenous" origin of a malignant state will be very rare, compared with the generality of cases. On the other hand, I would not say that some "virus-diseases" do not, now and again, "originate." According to my view of typhus fever, for instance, I think it is quite likely that the abnormal type of hæmetaboly characterizing the disease in the louse may sometimes "arise" as a pathological condition of the digestive function.

The Difference between Benign and Malignant Tumours.

I think that benign tumours and malignant growths have quite different causes of origin, and that the resemblance between them (such as it is) is largely due to the fact that increased multiplication happens to be a feature of both conditions.

It is most important to remember that, in single-celled forms of life (Protozoa), growth and reproduction are two distinct functions, which have no necessary correlation. The young (small) forms of an individual may

divide as well as the full-sized adults. On the other hand, in the Metazoa, the growth-size function, not only as regards organs and tissues, but also in very great measure as regards many types of cell, has been secondarily taken over, as it were, *by the multiplicative function of the cell-individual, which has (necessarily) lost its original significance of reproduction* (for the survival and spread of the species). With one or two exceptions "growth" is attained by increase in number of the cells, rather than by their increase in size. Body-size depends on the total number of cells rather than on their size individually considered (Wilson, "The Cell"). It is only very rarely that the individuals of a particular type of tissue-cell show variation in size comparable with that which is frequently found among Protozoa.

Hence, I regard benign tumours as indicating a disturbance (hyperactivity) of this growth-size function *on the part of cells*, either as components of tissues, or as individuals, which is expressed in this manner. But, just as in the case of the increased exercise (or other disturbance) of other cell-functions, this of itself does not mean malignancy; neither does it necessarily produce a malignant condition. The vital equilibrium of the cells, their power of responding to the co-ordinating control of the body, is not upset. They are still behaving (apart from their increased "growth"-rate) as members of the tissue of which they form a part. And they are *not living on the blood-elements* in the manner in which they do in malignancy (contrast in general the slow rate of increase of benign growths with the rapid rate of malignant ones). As in other cases also, however, this condition may, and often does, lead to a depressed state of the cell-vitality in certain "weakly" individuals; and then results the cell-revolt which is indicated by malignant behaviour.

If we regard the view of malignancy which I have above considered as a working hypothesis, does it afford any indication of rational lines along which attempts to find a therapeutic cure may be pursued? I think there are two: (1) in the direction of counteracting the blood-digestive enzyme; and (2) in that of substituting some other metal for the iron of the ingested organized material. I will venture to illustrate these two lines by suggestions, but whether they will be considered promising enough to try is quite another matter.

(1) This implies the application of sero-therapy; an attempt to obtain anti-bodies to the enzyme. I take it that efforts to obtain anti-bodies by inoculating extracts of growths into other animals and subsequently using their serum have often been made? Indeed, from the whole character of the disease, and from the fact that self-recovery is (so far as is known) very rare one would fear such efforts would not be very promising; cancer is such an intrinsic cell-disease. (Prevention, by the development of a degree of immunity on the part of the cells, would be more possible, I think, along such a line, than the actual cure of a growth. Indeed,

it is not unlikely that, in the natural course, the cells of similar type, apart from the growth, may become "immunized," in the sense that they can not assume the malignant condition.) But there is one exogenous, infectious disease which, it seems to me, perhaps more nearly approaches malignancy in character—I mean as regards its principal mode of expression—than any other, namely, typhus fever. Here there is a greatly stimulated degree of hæmetaboly on the part of endothelial cells, which leads to an increased rate of multiplication. These macrophages are the cells which ordinarily, as a routine behaviour, exercise hæmetaboly in a manner most nearly approaching, perhaps, that in which cancer-cells are doing this. To this disease subsequent immunity, involving the production of anti-bodies to the virus (the hæmetabolic enzyme) can, of course, be obtained, at any rate in man. If anti-typhic serum, from immunized animals, could be procured it might, perhaps, be worth while trying this in the hope that cancer-cells might be affected thereby—at any rate, mesoblastic growths (sarcomata).[1]

(2) As I have emphasized, iron is necessary for the formation of chromatin. If voracious cancer-cells could be induced to take up some compound containing another metal than iron, they could not use this to build up chromatin, and in their exalted and unstable condition they might quickly be killed. I read that Professor Blair Bell, of Liverpool, is trying the effects of lead salts, apparently with a measure of success. The trouble, of course, is to obtain something which would be fairly "specific" and not toxic to the normal cells. Is it of any use suggesting an organic compound of some other metal (manganese, copper), such as is known to occur in the blood of certain invertebrates?

* * * *

Finally, there is one general point to which I may just allude. I sometimes think that many people are eating too much—not merely more than they require, but more than is good for them—in these days, in which many of us lead a relatively sedentary life and are not conspicuous for muscular development. If we eat a large quantity of iron-containing

---

[1] Since this was written, I see that Levaditi and Nicolau, in the course of their deeply interesting studies, have made certain observations (*C. R. Acad. Sci.*, 175, 1922, p. 1649), which are, I think, very important in this connexion. The authors find that the cells of (ectodermic) epitheliomata are no longer able to develop immunity to the vaccinia-virus. On the contrary, the tendency is for grafts inoculated therewith to gradually undergo necrosis and disappear. On my view of the enzyme-nature of these exanthematic viruses, such behaviour is quite comprehensible, and indicates that the malignant cells, by their assumption of the property of what may be regarded as basic hæmetaboly, have lost all cell-regulatory power of reaction *vis-à-vis* such abnormal ferments. The loss of the lesser control is included in that of the greater. And the point is that the pathogenic action of such an exogenous enzyme, against which the normal cells are able to acquire protection, might afford another, related, line of attack on the cells of a malignant growth. In this case, on the other hand, sarcomatous cells are only slightly affected.

food (e.g., meat) we are certainly helping, particularly, to make more blood. And, as I pointed out, the blood is that tissue to which, apparently, no limit is set upon its multiplication. Now, it has been generally assumed that the red corpuscles (restricting myself to these, as they vastly predominate) are "dying" as fast as they are being produced, and that the "effete" ones are eliminated by the macrophages, of one kind or another. I have grave doubts about this being the case.

It is, perhaps, endeavouring to probe rather deeply into the mystery of the co-ordination of the different tissue-systems, but on my view of general hæmetaboly, as a normal occurrence, I think it is most likely that this function, in its origin, served primarily as a means of keeping the numbers of the cells of the vascular system fairly constant and thus counterbalancing the much superior capacity and facility for proliferation possessed by these elements, especially the red-cell line. (Let us always remember that the metazoan body arose as a colony of little, *unicellular animals.*) It follows, therefore, that if a relatively large amount of hæmoglobin is continually being produced, and an insufficient proportion safely side-tracked, as it were (e.g., into the muscles), there may be an undue degree of hæmetabolic activity among various glandular and "secretory" tissues. And excessive functional activity may at length prove too much for some weakly cell-line!

It may be noted that coloured races have, at any rate, one "avenue of relief" which is not open to the white peoples. In their case, the entire cutaneous epithelium is able to exercise its normal mode of hæmetaboly (pigment-formation) and thus "account for," if I may so put it, a considerable quantity of hæmoglobin; whereas, in white races, this mode of utilization is very largely in abeyance. And in addition, moreover, many coloured races do not eat much meat. (Of course, this argument applies only to the above intrinsic set of predisposing factors. As regards others, e.g., special forms of chronic "external" irritation due to popular customs, etc., the tissue-cells of coloured races may be just as liable to be ultimately upset thereby as those of white races to corresponding ones. But the development of a malignant growth cannot by any means *always* be correlated with known "irritation.")

"*. . . There are men who work best in a team and men who prefer to work alone, and . . . there is ample room for both types.*"—(From an article on "National Health and Medical Research," by "J. C. G. L." *Nature*, March 31, 1923, p. 422.)

"*The endowment of research in general, rather than cancer-research in particular, may be better policy than to attempt to induce men of imagination to restrict their range.*" (*Brit. Med. Jour.*, June 17, 1922, p. 964.)

REFERENCES.

[1] Acton. "Melanotic Growths." *Ind. Journ. Med. Research*, ix, 1922, 464.
[1a] Arkwright. "'Virus-diseases' of Animals," *Ann. Applied Biol.*, x, February, 1923, 55.
[2] Beatson. "Has Cancer a Pigmentary Origin?" *Lancet*, 1922, ii, September, 655.

[3] BORRMANN. "Die Entstehung und das Wachstum des Hautcarcinoms," *Zeitschr. Krebsforschg.*, ii, 1904, 1.

[4] CREIGHTON. "Some Conclusions on Cancer," London (Williams and Norgate), 1920.

[4*a*] DYSON. "Cutaneous Pigment in Normal and Pathological Conditions." *J. Path. Bact.*, xv, 1911, 298.

[5] FULTON. "Animal Chlorophyll; its Relation to Hæmoglobin and to other Animal Pigments," *Quart. Journ. Micr. Sci.*, lxvi, June, 1922, 339.

[6] JORDAN. "The Histogenesis of Blood-Platelets in the Yolk-Sac of the Pig-Embryo," *Anat. Record*, xv, February, 1919, 391.

[6*a*] *Idem.* "Comparative Microscopic Study of the Melanin-content of Pigmented Skins," etc., *Amer. Nat.*, xlv, 1911, 449.

[6*b*] LAPAGE. "Cannibalism in *Amœba vespertilio* (Penard)." *Quart. Journ. Micr. Sci.*, lxvi, 1922, 669.

[7] PARHON and DÉRÉVICI. "Recherches expérimentales sur les hémorragies intrafolliculaires, les hématies basophiles et la colloide hyperchromophile du corps thyroide," *Compt. rend. Soc. de Biol.*, lxxxviii, April, 1923, 950.

[8] REINKE. "Ueber direkte Kerntheilungen und Kernschwund der menschlichen Leberzellen," *Verh. anat. Ges.*, 12te. Versammlg. Kiel, 1898, 86.

[9] ROUS, PEYTON. "A Sarcoma of the Fowl transmissible by an Agent separable from the Tumour Cells," *Journ. Exper. Med.*, xiii, 1911, 397.

[10] WOODCOCK. "An Introduction to the Study of Hæmatophagy," JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, xxxvii, 1921, 321, 428.

[11] *Idem.* "Hæmatophagy and Hæmetaboly as a Normal Function of Various Types of Tissue-Cell," *op. cit.*, xxxviii, 403, and xxxix, 1922, 14.

[12] *Idem.* "Are the Active Principles of Filter-passing and 'Ultramicroscopic' Viruses Living Organisms or Enzymes?" *op. cit.*, xxxix, 1922, 243.

[13] *Idem.* "Rickettsia-bodies as a Result of Cell-digestion or Lysis," *op. cit.*, xl, 1923, 81, 241.

[14] WOODCOCK and LODGE. "Parasitic Protozoa." In: Reps. "Terra Nova," Antarctic Exped., *Zoology*, 6, No. i, 1921.

EXPLANATION OF PLATE FIGURES.

(All are photomicrographs, kindly taken for me by Dr. D. J. Reid. All are magnified 300 diameters, with the exception of fig. 4, which is 500 diameters. For full description, see text.)

FIG. 1.—From a blood-smear of a guinea-pig in which "phagocytosis" had been induced (kindly given me by Dr. Bedson). Two large mononuclears, each containing a recently ingested red corpuscle and a pale hæmoglobin-"vacuole," are shown. Polychrome methylene-blue.

FIGS. 2-4.—From a very early epithelioma of the gum (section kindly given by Dr. Reid). Cancer cells in down-growing epithelium, containing ingested corpuscles in early stages of digestion. Dilute Delafield's hæmatoxylin, not counterstained; the staining is, unfortunately, not very precise.

In fig. 2 the arrow points to a cell containing two separate, included corpuscles, one on either side of the nucleus. In figs. 3 and 4 the arrow indicates a cell containing two corpuscles, side by side, but still separate, which have well retained the stain.

FIGS. 5-7.—From a very early epithelioma of the lip (section kindly lent by Dr. Leitch). To show the extent to which hæmatophagy and hæmetaboly are taking place in the actively growing and extended areas. Hæmatoxylin and eosin.

FIG. 5.—(*a*) Points to pale corpuscles, in intercellular channels. (*b*) Two cells, each of which contains an ingested corpuscle, the one to the left being pale, the other tinted with the eosin. (*c*) Another cell, similar to that last mentioned; note the crescentic nucleus, partially wrapping round the corpuscle. (*d*) Another cell containing a pale hæmoglobin "vacuole."

FIG. 6.—(*a*) Points to a capillary, the endothelial nucleus of which is very faint and appears to be disappearing. (*b*) A capillary into which a large cancer-cell nucleus has penetrated and caused the corpuscles to "run together" into a pale hæmoglobin mass.

FIG. 7.—(*a*) Cancer-cell nuclei "bathed in" hæmoglobin. (*b*) Large nucleus, with a hæmoglobin "vacuole" on either side, that on the right being formed of a single corpuscle. (The black mass at the right-hand side is a piece of debris which is, unfortunately, lying on the section.)

FIGS. 8-12.—From a young carcinoma of the tongue (sections made by Dr. J. D. Thomson and myself). To show the predilection of the cancer-cells for polymorphs, after the earliest stages of the growth. Sublimate alcohol acetic; Giemsa. The section from which fig. 10 was taken was, unfortunately, somewhat over-differentiated.

FIG. 8.—Two finger-like processes of active cancer cells pushing into the stroma (to the north of the field). The arrow indicates a cell containing in its cytoplasm both a polymorph and a red corpuscle. The dark body to the right is the huge nucleus of another cell. In the finger on the left a nucleus is seen in mitosis.

FIG. 9.—Rapidly growing cancer cells invading an area occupied by numerous polymorphs (to the north). These are becoming surrounded and ingested by the cancer cells. The arrows point, respectively, to a minute capillary, a large, multi-lobed nucleus, and to another in the act of mitosis.

FIG. 10.—Lacuna, surrounded by cancer-cells, which contains several polymorphs. Two cancer-cells have invaded the lumen, which is largely filled up by their cytoplasm, and some of the polymorphs are definitely included therein.

FIG. 11.—Morula of large cancer-cells, occupying what has probably been a lacuna containing blood-elements. The arrow points to an ingested polymorph and red corpuscle.

FIG. 12.—Large lacuna, surrounded by cancer-cells, containing blood elements in various stages of alteration (digestion).

POSTSCRIPT.

I SHOULD like to add, even as this goes to press, that only a few days ago I came across a reference to a paper by Leupold (*Ziegler's Beitr.*, 59) on the important question of the auto-lysibility of the red corpuscles. This worker kept blood in a sterile condition for three or four weeks. He found that, while some corpuscles suffered changes due to osmosis (crinkling, slight shrinkage, and so on), many remained unaltered the whole time, and there was absolutely no pigment formed. If, however, a minute fragment of tissue was added, containing an autolytic ferment—e.g., kidney—a granular brown pigment quickly developed, which gave the iron reaction. The author concludes that red corpuscles contain no autolytic ferment and are durable ("dauerhaft"). This is most important from my point of view.

FRAGMENTS.

By Colonel Sir ROBERT FIRTH, K.B.E., C.B.

XXXIV.

To-day, at the club to which I belong, they gave us a prawn curry for lunch, and as I sat enjoying the meal and qualifying for a possible aftermath of digestive trouble I could not help thinking how the prawn, in addition to providing us with a very edible dish when dead, was also an interesting creature when alive. By virtue of the chitinous and tough envelope in which it is enclosed and to which external skeleton its muscles are attached, the prawn, like its relatives the lobster, crab and shrimp, belongs to the class Crustacea. Its outer envelope is made up of a number of sections jointed together by means of a flexible tough membrane, except at the fore part where it becomes an unjointed shield under which are the gills. The unyielding nature of this chitinous body-covering renders growth impossible without a periodic casting of the entire coat, to say nothing of the chitinous lining of certain inner tubes. This actually happens, for prawns exuviate as often as once or even twice a month. When the time arrives for a prawn to rid itself of its uncomfortably tight skin it ceases to feed and searches for a convenient place at which to undress. This spot having been found, the three hinder pairs of legs are hooked firmly to a suitable support in such a way that the body is able to sway about freely. Aided by a series of sudden jerks, the swaying movements gradually loosen the whole surface of the body from the encasing cover. Even the eyes are moved in their coverings. Gradually, the shell splits between the front shield and the legs, then slowly and carefully the head, the antennæ and the legs with the rest of the body are withdrawn until, with a final sudden jerk, the prawn frees itself, leaving its discarded coat still clinging to its anchorage by the six hooked claws.

When first set free, after this unrobing, the prawn rolls helplessly on the sea-bed owing to its legs being so soft as to be unable to bear its weight. Presently, by alternate bending and straightening of its body, coupled with a stretching of its tail-fans and finlets, the prawn wriggles along to find shelter in some safe nook until its new covering is hard enough to afford it protection. Emerging from its retreat in this new coat, the prawn is really beautifully clothed and a very different looking creature to the dull red crustacean so familiar to us on the fishmonger's tray for, to an even greater extent than the shrimp, the living prawn differs in colour from the boiled dead specimens we know so well. When alive, the colours of the prawn are bright and clear, more especially the orange and rich brown bands upon its pale blue forelegs. The body of the larger species is of a translucent grey spotted and striped with brown and red, while the smaller

species are striped transversely with deep olive-green and purple on similar translucent grey. The species vary somewhat in colouring, but the general scheme is such as to render the creatures very inconspicuous on or near the sea-bed. Other distinguishing features of the prawn (*Palæmon serratus* and *P. squilla*) are the long antennæ, the prominent eyes and the well-developed finlets which lie just in front of its powerfully constructed tail-fan. These features make it an easy graceful swimmer combined with a wide range of vision and keen senses of smell and touch. It has ten pairs of legs which are tucked close under the body when swimming. To its long antennæ the prawn owes its acute senses of smell and touch ; the former is so remarkable that, if a small particle of food be dropped into the water, the moment the antennæ pass across the track of the food particle, the prawn darts rapidly about in search of it ; and, even, after it has been found and eaten, a second prawn, on exploring the same water, will pick up the scent and search diligently for what has already been devoured though evidently leaving an odour behind it.

Having said so much about the prawn, I would add a word or so concerning his near relative the shrimp, *Pandalus annulicornis*, or Æsop's prawn as it is sometimes called, because, like Æsop, it has a humped back. Much the same size as *P. squilla*, it is largely fished for market, and in its native element is a sand-coloured creature speckled with bright red-brown spots with its antennæ characterized by red and white bands. So admirably does this coloration harmonize with the sandy sea-bed that its habit of burying itself seems scarcely necessary. Although rapid in its movements, the shrimp spends most of its time on or in the sand, being a far less powerful swimmer than the prawn, from which it also differs by being squatter or flattened from above instead of laterally and lacking the notched beak or rostrum, which as a curved cruel-looking weapon projecting forwards from the head-shield is so characteristic of the prawn. All this family seize their food by the pincers with which the first pair of legs are armed. These pincers have short hairs like a brush which stand out at right angles to the claw, and with these a prawn and shrimp clean every part of their bodies, standing all the time on the other eight stilt-like legs.

While neither the common prawn nor the shrimp is devoid altogether of power of mimicry, it is greatest in some of the smaller and less well-known members of the family. For instance *Hippolyte varians*, which is a beautiful little creature some three-quarters of an inch in length, shows such powers of changing colour in harmony with a change in environment that a bright green specimen placed in a vessel with red seaweeds, will, within an hour, become as red as the seaweeds ; while red specimens placed among green seaweeds change equally rapidly to bright green. By virtue of this mimetic habit, the *Hippolyte* will be found to be brown, red or green according as to whether we find it on sand, ruddy weed or sea grass. In a lesser degree, the prawn, motionless and almost invisible, reproduces

not only the colour, but also the pattern of its background, exhibiting marbling or uniformity according as the light is more or less broken up by the forms and colouring of the sea forests; and as there is an infinite variety of colour gradation in this water foliage so does the livery of the prawn vary from red to violet. The mechanism of these colour changes is undoubtedly located in living pigment cells which change in size and shape under nervous influences. In some cases, the changes appear to be controlled through the visual organs, as blindness renders the apparatus ineffectual, but this is not so with the prawns. In some of them, especially Hippolyte and Æsop's prawn, it would seem as if light and darkness had played alternately so long upon the nervous system as to produce a rhythmic habit of action and repose corresponding with night and day. Thus, for choice these creatures sleep during the day and assume the colour of the chosen couch, but at nightfall, even if placed in artificial light, no matter its colour during the day, the creature changes to an azure blue, swims rapidly about and retains its blue tint till daybreak when, assuming its daylight hue, it again sinks to rest and sleep. Having thus jotted down what little I know about the prawn, I ask the reader to think kindly of the little creature and his brethren when next he eats a prawn curry.

XXXV.

In the last fragment attention was drawn to the highly developed sense of smell in the prawn; it is curious to note how large a part odour, scent and the sense of smell play in the economy of nature. To most people it is the existence of scent among flowers which is most familiar and obvious. There was a time when the sweet scent of flowers was regarded as being exhaled solely for the pleasure of man, the idea being in conformity with the belief that all the living things of the earth had their being with reference to his needs. We take a broader view in these days and, although there may be a meaning and value to mankind of perfume in flowers and plants, we recognize that the property has a chief reference to the life and needs of the plants and flowers themselves. We know that the perfume of flowers constitutes the allure for insect visitors by whose agency pollen is transferred from one flower to another, thereby securing improvement and strengthening of stock by cross-fertilization or causing fertilization when self-fertilization is impossible. An interesting side issue associated with the scent of flowers is that of colour. A popular generalization is to the effect that brightly coloured blossoms are seldom scented while the inconspicuous ones usually are. This is not strictly true, for there are many exceptions to the rule. Many observations have been made by various observers as to the connexion between perfume and colour in flowers, and the ratio of scented species to non-scented species in each colour has been estimated to be; whites, 1 to 6·4; reds, 1 to 10·8; yellow, 1 to 12·6; greens, 1 to 12·7, and blues, 1 to 19. This indicates

how comparatively few scented flowers there are in relation to the total and that white flowers have twice as many of their number scented as yellow or green flowers, and three times as many as blue flowers.

An old clergyman, with whom I lived when a boy, used to descant much on this subject, especially on the relationship between the colour and perfume of flowers and the insects that frequented them. He used to teach us that flies prefer greenish-yellow or brownish-yellow flowers and told us to go and look for flies on the bloom of the ivy and parsnips, similarly he said wasps had a predilection for brown-red flowers, while the paler red and dingy violet flowers were the favourite haunt of beetles and carrion flies. His theory of the preference in the three cases was the resemblance in colour and odour to a manure heap, rotten fruit and putrid flesh respectively. The idea may seem far-fetched but it is supported by the fact that certain flies resort to and devour the very malodorous slime emitted by and in which the ripe spores of the common fungus, *Phallus impudicus*, are embedded. Similarly, certain foreign arums are peculiarly attractive for carrion flies because the spathe looks and smells like decomposing flesh, and it is not unusual for blow-flies to deposit their eggs upon it under the impression that they are ovi-positing on flesh. The result is that when the maggots hatch out they seek in vain for food and perish. In general terms it may be said that unpleasant odours are related to dull or dingy colours in plants and flowers, while pleasant odours are found usually in connexion with those of bright colour. White flowers, in particular, are often sweetly scented; it is such flowers that are most conspicuous at night and the haunts of moths and other night-flying insects. It is noteworthy too that many of these flowers emit a much more powerful scent at dusk than during the day. This suggests some connexion between the development of perfume and the state of the atmosphere; humidity with a certain degree of warmth appears to be the dominant factor as suggested by the honeysuckle which invariably becomes more powerfully scented on a warm evening, while the outdoor violet plucked in early spring is almost odourless until taken into a warm room.

Theories have not been wanting that perfume from plants and flowers may act as a kind of invisible screen, especially in dry hot places, against the sun's direct rays. The basis of these views are certain observations of Tyndall upon the heat absorption power of some of the essential oils and aromatics. In the light of modern knowledge, the value of the idea seems small, but the notion has some interest correlating with the old-time belief in scents and perfumes as prophylactics against infections. To a survival of this belief we owe, in our own day, the carrying of bags of camphor, or naphthalene balls, or lavender, or bottles containing one or other of the essential oils as amulets and talismans for warding off the influenza or other infections. There appears to be no need for any such fanciful ideas to account for the rôle which scent and perfume play in the economy of plant life for apart from being an allure to useful insects as

agents for fertilization, they discourage the eager attentions of browsing animals in regions where fodder is scarce. Nearly all grazing animals dislike strongly-scented food, and carefully avoid those plants or parts of plants which thus offend their sense of smell; further, many objects without odour to us may be, and probably are, distinctly odorous to animals with their keener sense of smell. In some plants such as the lavender and rue, the foliage and the flowers have the same scent, so that enemies are repelled and friends attracted by the same means. As a rule, the scent of a blossom is quite distinct from that of the leaves of a plant, notable examples are the coriander and hemlock, the leaves of which have a most objectionable smell while the flowers are delicately perfumed; it is the same with garlic, in which the perfume that attracts insects to its blossoms is quite different from the onion-like odour which repels grazing animals from making a meal of the juicy leaves.

In the animal world scent is as full of significance, as fully varied in its nature, and as widely distributed as it is in the plant world; further, its main value is to attract friends and repel enemies. The weasel, stoat, polecat and skunk at once come to mind as examples of odoriferous mammals. In each of them the ability to emit a noisome scent is probably a mainly defensive action. The polecat, which is not a cat at all, is as objectionable for the nauseating odour which emanates from its body as it is for its fierce and marauding habits. The odour is due to a secretion from a gland or pouch near the tail, and the emission of the foul-smelling secretion is largely under the animal's control, being put into force when the creature is annoyed or wounded. But of all animals of the *putorius* family the skunk is pre-eminent for its noisome odoriferous qualities. The potency of the weapon it possesses in its sub-caudal stink-glands is such that incautious hunters have been blinded for life by a discharge into the face of the caustic and disgusting liquid. Even birds of prey, such as hawks and eagles, have been known to be obliged to abandon their victims on receiving a spray in the eyes and face of the same horrible secretion.

Scent, as a signal to friends, plays an important rôle among social animals. The rabbit is a familiar example whose characteristic smell is produced by a pair of glands in the hinder part of the body. The pig-like peccary of South America has a gland on the back which secretes an oily, evil-smelling fluid, the scent of which helps to keep the herd together at night when foraging for food. A similar use of scent as a means of recognition and keeping the community in touch with each other is to be found among sheep, deer and antelopes. Between the toes of sheep are bottle-shaped glands from which ooze drops of a strong-smelling secretion which doubtless serves as a trail to be followed by any stray member of the flock. True, such a trail can be as easily followed by an enemy, but this fact may be neutralized by the safety which exists in numbers. In many deer and antelopes there is a scent-gland below the eye and the drops that ooze therefrom furnish a trail by which wanderers may re-find the herd. In

some other species, such as the musk-deer, the males emit a smell of musk, at certain seasons of the year, from a special gland to attract the females of their kind, a fact which suggests that the sense of smell plays a part in connexion with the propagation of species.

Among birds, the part played by scent and smell in the economy of their kind appears to be small, as the only instance which I can recall is that of the fulmar petrel, which has the objectionable but distinctive habit of disgorging a peculiarly fœtid yellow liquid when threatened, the stench of which will drive away any intruder anxious to take its eggs or disturb its young. Among the humbler living creatures, the cockroach has a bad repute on account of the disagreeable odour which pervades its haunts and taints everything over which the creature crawls. This objectionable smell proceeds from a pair of glands on its back, the secretion being given out especially when the cockroach is excited or disturbed. Many true insects find a means of safety in their own evil smell which, in some cases such as the ordinary bug, is constantly emitted and curiously persistent. On the other hand, the so-called bombardier beetle only shoots out its own particular but very unpleasant fluid from the end of its body when danger threatens. The ejected liquid, whether it really gives or does not give the alleged bomb-like effect of noise and smoke, is sufficient to stave off any pursuer and thus enable the bombardier to escape into safety. Anyone who has kept bees will know that they, too, have a scent; in some species distinctly fragrant and in others very much the reverse. At the home of my youth, we kept many bees and I well recall their fragrance which was quite independent of the perfume coming from the pollen with which they were so often laden and doubtless a means of recognition between individuals of their communities. One particular genus that was curiously devoid of fine hairs and particularly fond of mignonette, we used to call the citron bee because when one was handled it left an odour of that fruit. In a similar way, the humble-bees and stag-beetles are known to emit attractive odours but, in their cases, it is designed specially to attract the opposite sex. When the queens of the humble-bee are reared in July and hidden away in holes and crevices, the male pauses at a likely hiding place and emits a pleasing scent to lure the female from her retreat. Conversely, the female stag-beetle hidden in the foliage of bush or hedge is discovered by the horned male in the summer dusk by the alluring odour which the lady emits for his enticement.

Few people realize how large a part scent plays in the life of butterflies and moths and that many of them are as fragrant as the flowers they frequent. Many apparently odourless species emit odours so faint that we are unable to detect them, but yet powerful enough to be perceived by insects of their own kind. I have been guilty of collecting butterflies and moths myself and often noticed that when some precious capture of a female necessitated transport in a matchbox, her presence was detected by males which seemed to come from nowhere and hovered around the prison. The

perfume of butterflies and moths is given out by bunches of fine hair on the legs and body and also by special scent-scales on the wings. Anyone who examines the male *clouded yellow* can easily find the chalky-looking scent-scales on each of his hind wings. In the majority of moths and butterflies, the scent appears to be confined to the males, but it has been noted that when both sexes are scented the odour is usually unpleasant to man and more pronounced in the female. This suggests the interesting question as to what is the object of the conspicuous colour in some of these insects when both sexes emit unpleasant odours, for such is the arrangement. The answer would seem to be that the odours are protective and the colours recognitive or premonitory, also it is not improbable that the differences between the scent-scales of the two sexes in closely allied butterflies with common premonitory colours may be a provision of Nature to facilitate recognition by the opposite sex of the same species. Here, I would leave this interesting subject except to remark that may not the prevalent habit among human females to scent themselves be an unconscious reversion to primitive type whereby, even in man, perfume, if not too aggressive, plays its part in the courtship of the sexes, and, when otherwise, is a repellant and warning to the male to keep away and pass on the other side? Experience shows that such is not infrequently the case and that men and moths have much in common.

XXXVI.

Readers of this Journal know my weakness for writing. It occurred to me recently to calculate the extent of my vocabulary, and I was surprised to find how relatively small was the total number of words upon which I drew; in fact my vocabulary appears to be rather less than half the stock upon which Shakespeare drew, and he is credited with a vocabulary of some fifteen thousand words. The important thing, however, is not so much the quantity as the quality of the words we use, whether it be in writing or speaking. Words are the bricks with which we build literary edifices, they are, moreover, common property and as chameleonic in practice and effect as the tints on a cock pheasant. Practice in words is not only audible and legible, we think in them, can dream in them, we make magic with them, we comfort and even wound or injure with them, we pray in them and we die with a few of them on our lips. This being the case, does it not behove us to be more critical in our use and selection of words, and should we not be bolder, more human, humorous and idiosyncratic in our efforts to acquire them and thereby become articulate in not only good but pure English? Further, since our tongue bids fair to be the chief language of civilization, it must be adaptive, catholic and hospitable; unfortunately, it is subject to no guidance and to very little intelligent criticism with the result that many speak and write English with little thought as to the processes and forces which have formed it in

the past and still less thought of the need that the new elements added to it should be in harmony with the old. My theme, therefore, is that we who profess to write and talk English should employ an English truly characteristic of the language, however derived, and to indicate briefly the directions in which danger lies, more particularly the modern tendency to borrow alien words without due need, the failure to keep *ours* ours, and the neglect of short, simple words and of those from the local vernaculars which are at once both the nurseries and sanctuaries of true English words.

With regard to foreign words recently borrowed from abroad, literary taste seems at the present time to be scientifically incorrect and tending to impair the national character of our standard speech. Instead of being assimilated, as they were in the past, and brought into conformity with the main structure of our speech, our borrowed terms, especially those from the French, are now spelt and pronounced, not as English, but us foreign words. Not only this, but such words are constantly printed in italics which is another active force towards the degeneration of our language. Much of this is mere pedantry and, as the result of a false taste in this matter, many words which have long been naturalized in the language are being now put back into their foreign forms and our speech thus gradually improverished. Just as certain ardent enthusiasts on phonetics would reduce our commonest vowel sounds to an indiscriminate *er* and say "we went frerm Brightern ter Margit ernd then ern ter Bernmerth," and certain modern versifiers would sacrifice metre and rhyme to their passion for what they call "free" verse, so there are genteel writers who prefer to write *impasse* or *cul-de-sac* when they mean a blind alley; they say and write *résumé* when they mean an abstract or summary; *melée* is written for mellay, *naiveté* for naivety, *flair* for flair, *technique* for technic, *clinique* for clinic, and yet the same people have no difficulty in using the English form, "employee" in place of *employé*. Admittedly, if we have no equivalents, we must make use of foreign words to meet the needs of our time, but, even so, surely it is better that we should put them in English garb and so incorporate them in our language as available for common use. In this manner a useful word like *malaise* could with advantage take the old form "malease" which it once possessed, and words like "nuance" and "naivety" had much better be pronounced and written as English words. Many other examples might be quoted.

Another form of the useless and pedantic process of the de-assimilation of words is the current practice of restoring foreign plural forms to words borrowed from Greek, Latin and Italian. It may be accepted that no common noun is truly assimilated into our language and really available for popular use until it has an English plural. For example, we no longer write *asyla*, *musea*, *chori*, *ideæ* or *specimina* for asylums, museums, choruses, ideas or specimens, and anyone who wrote "the ideæ of music implied in the chori suggested specimina of inmates from rival asyla" would

be laughed at. And yet this very process is now going on and sanatoria, memoranda, gymnasia, automata, formulæ, lacunæ, miasmata, indices and apices are replacing the plain English forms of sanatoriums, memorandums, gymnasiums, automatons, formulas, lacunas, miasms, indexes and apexes, while to make matters even worse publisher's readers have even allowed to pass such barbarisms as chimeræ, lexica and rhododendra. I suppose the next stage will be that our newspapers will write of chinese *banditti* instead of bandits. Undoubtedly, some of these words have exceptional uses; thus, when used collectively, memoranda and automata are pardonable. So again, when the classical form is a scientific term it is desirable to preserve its differentiation and use *foci* and *indices* in mathematics and *formulæ* in chemistry or medicine; but these are exceptions to a general rule which demands that, whenever there is a choice, the English form of a word is to be preferred; otherwise, a little knowledge becomes indeed a malevolent thing.

The above remarks touch the fringe of the special question of scientific terms. These are far too numerous to have any chance of admission into the common vocabulary; they are outside and must establish their own proprieties and conveniences for themselves on their own lines. Nevertheless, there is, between the basic national vocabulary and the recondite differentiation of unfamiliar things, a margin of words which it is important to control. This is particularly the case in some departments of medicine, especially anatomy which has a wide basis of good wholesome English words, in such names as neck, head, chest, thigh, leg, knee, ankle, foot, wrist, hand, etc. Strictly speaking such English words should be used in preference to any alien terms, but in spite of this we are obliged to speak of *cervical* and *femoral*, etc. The reason is that we are unable to make English adjectives out of English nouns by adding English suffixes to them, and when driven to it, have to fall back on the device of using the substantive adjectivally, as when we say thigh-bone. This is inconvenient, hence we have introduced so many Latin adjectives and say freely cervical, crural, cardiac, cerebral, mental and manual. True, they might be avoided by manipulating the common speech words but it would lead to trouble and inconvenience, particularly in the making of compounds descriptive of relation; for who could coin out of pure English words a term at once so exact and expressive as ileocæcal for the valve at that juncture? Again, in science, these Latin adjectives give the clue to the noun from which they derive and, likewise, structures and things that have failed to attain clear differentiation in vulgar speech tend to secure it by their Latin names. A good example of this presents itself in our own legs. The true English names for the two bones of the leg are the *shin* and the *spele-bone*; but in the language of the kitchen and butcher the word "shin" may include both the leg bones, and, in the horse, shin is a metacarpal bone, therefore the term "shin" in common language is ambiguous. We get over the difficulty by borrowing from the Romans,

who saw in the main bone of the leg a resemblance to a flute or pipe and consequently called it the *tibia*; at the same time they saw in the smaller and outer bone of the leg a resembance to a brooch-pin and called it the *fibula*. Obviously, it would not do to translate the terms and use their original meaning then, just as *iceberg* is better than *icehill*, so to speak of the two bones of the leg as tibia and fibula is better than saying flute and brooch-pin, especially as there is no need to add *bone* and both tibia and fibula connote their indispensable adjectives. The weight of evidence, therefore, is in favour of the abundant classical terminology not only in anatomy but in medicine and science generally; it is in close relation with common speech, often an extension of it, defensible for scientific purposes and internationally convenient.

This general conclusion, however, is subordinate to certain general rules. The first is that Science should write and speak in the national language, and employ national terms wherever they are suitable. Failing convenient national terms, then Science must use Latin or Greek terms. A second rule is that Latin nouns, even when retaining their Latin form, become English words, and may ultimately take on an English form, and when this happens the latter is preferable. Thus, the English forms clavicle, canal, cubicle, nerve and tubercle are better than *clavicula*, *canalis*, *cubiculum*, *nervus* and *tuberculum*; on the other hand, the Latin terms, *camera*, *stimulus* and *stratum* have become English words without changing their form. A third rule is that in current English a Greek noun may become English in either its original Greek or acquired Latin form, or even take on an English form. The following examples may suffice. *Panorama* is Greek in form, so is *chorion*, but *thalamus* and *chrysanthemum* are Greek in a Latin form, while *theatron*, *systema* and *chasma* have been changed into the English forms theatre, system and chasm. Further, a Greek noun may form its adjective with either a Greek or a Latin termination; as to which is the more preferable, learned opinion in the majority of cases inclines to favour the Latin termination, thus the better adjectival form from *condyle* is condylar rather than condylic or condyloid. This is in contravention of the view of purists who insist on Greek and Latin nouns always retaining their proper linguistic suffixes, and would have us say theatric instead of theatrical, and practic instead of practical, which most will agree would be offensive to both ear and eye.

In this place, mention may be made of our familiar suffix—*itis*, so much favoured by doctors. In the medicine of the Greeks it signified disease of an organ, as in *arthritis*, and is, perhaps, most familiar to the general public in the word *appendicitis*. I well remember the outcry against the term when it first became the name for a fashionable complaint, but etymologically the word is defensible; on the other hand, the proposal to write or speak of *lithitis* is unpardonable, as it would mean the disease of a stone and not the diseased condition caused by a stone. The most successful use of suffixes by science is that represented by chemical nomenclature

which employs one special suffix for one special form of combination, and another for another. Thus, all newly-discovered metals are given names ending in *-um*, no matter from what language the name is derived, familiar examples being *chromium* from the Greek, *calcium* from Latin, *strontium* from Scottish, *thorium* from Scandinavian, and *platinum* from Spanish. The names of the non-metals do not end in *-um*. Further, the suffix-*ane* indicates a normal paraffin, *-ene* indicates a homologue of the ethylene series, *-ol* indicates an alcohol, and *ine* indicates a basic substance, while *-in* is restricted to certain neutral compounds. In a similar way, the suffixes employed for names of chemical compounds indicate their composition; thus, *-ide* is typically applied to a compound of two elements, *-ate* to one containing these two elements and oxygen, *-ite* to one containing less oxygen than the *-ate* compound. The suffixes *-ic* and *-ous* are used to indicate different proportions of constituent elements, but where more precision is needed may be replaced by the Greek prefixes *mon-*, *di-*, *tri-*, etc.

Much more might be written concerning the coining of scientific names, but I would limit myself to saying that structures and things should not have more than one Greek or Latin name. Unfortunately, this rule is not observed, and doctors are notable sinners in respect of it, for they name a boat-shaped bone indifferently from the Greek word *scapha*, and the Latin word *navicula*, both of which mean a boat. Another mistake to avoid is the putting two Greek or Latin words together, and this applies to both names and adjectives. Many hybrids of this kind are found in the English of daily life, and it is difficult to say how they are to be excluded, for who now can drop the use of such words as "automobile" (Greek and Latin), or "bureaucracy" (French and Greek), or "hypersensitive" (Greek and Latin), or "interweave" (Latin and English)? They are interesting examples of the results of evolution of a language in the course of more than two thousand years.

I would pass now to the subject of dying words because they typify another kind of impoverishment from which our language suffers, and the pity of it is that it is a kind of blight which attacks many of our oldest, beautiful and expressive words, rendering them first of all unsuitable for colloquial use, then driving them from prose to poetry, and finally casting them into the limbo of archaisms. The fate of many beautiful old words has thus been decided or is in the balance; examples which I have in mind are maid, damsel, weep, bide, seek, sojourn, dole, delve, dwell, chide, heinous, swift, lilt, pelf, eerie, shun and murk. Many of them are tainted words and usage in regard to them varies; some of them like *delve* and *dwell* still linger in metaphors, since people still speak of delving into their minds and dwelling in thought, yet would never think of delving in a garden or dwelling in London; others do not hesitate to call their enemies *hounds* and *swine* and yet would be shy to use these words for the animals they properly designate. It is not uncommon to hear of a *swift* punishment, but

a smile arises if we speak of a *swift* train or horse, and we have no difficulty to *shun* a thought but find it less easy to shun a bore. Perhaps the reader will bear some of these words in mind and by a slight effort introduce them into his vocabulary, even at the risk of suffering in a good cause under the possible imputation of affectation.

Whether words may, by conscious effort, be preserved in colloquial usage is open to experiment but, undoubtedly, there are many excellent words spoken in dialect and uneducated speech all about us which are well worth preserving by an introduction into our standard or current vocabulary. Their great merit is that they are genuinely English. Others are new formations, coined in the ever-active mint of uneducated speech and many, like blight, nag, fun, gallivant, cantankerous, swank, harum-scarum and pernickety, are full of freshness and vigour out of the vivid popular imagination. Many of the dialects and words in common use among country folk provide a wide field in which we might and should find terms and words essentially native and sufficiently expressive to warrant inclusion in our standard speech. A few come to mind, such as dight, malison, lewd, douce, fash, starve, nesh and hypped or hipped. Both "nesh" and "starve" as meaning feeling pain or cold are heartily alive still in Lancashire, Yorkshire and Derbyshire, and if they have satisfied those people for a thousand years it would not be derogatory to southern speech if they and some other words were accepted in our domestic vocabulary. "Hyppish" is the Englished form of hypochondriacal and was used by Swift, Berkeley and Gray, but owing to its getting confounded with "hipped" as meaning a horse lamed in the hip it has fallen on evil days, while "hipped" nowadays has no more definite signification than incapacitation in mind or loins and being out of sorts.

While every student of our language knows that Anglo-Saxon is its framework and the spine on which the structure of our speech is hung, and that it is to the classical and romance words, borrowed during the last three hundred years, we owe its spiritual conceptions, yet, as a true scholar, he will manifest a partiality for neither part of the language but be governed in his choice of words by the theme he is handling, still it is difficult to be unconscious of a modern tendency to neglect the clear, short and beautiful words which come to us from the Saxon. In this connexion, it is a curious fact that while we can readily frame a sentence wholly from Anglo-Saxon, we cannot do so with words entirely classical or romantic in origin, because the determinative particles, which are the bolts and hinges of the structure, must be Saxon. This does not mean that the words which we have built up or borrowed from the Greeks and Latins should have no place in our language or that we should fail to use them. The gamut of ideas needs a corresponding gamut of expressions. The classical words are indispensable to a writer or speaker not only as to subtilty of thinking but also as to elevation and sublimity. Our language has a special dowry of power in its double-headed origin; the Saxon element fulfils one set of functions, the

classical, another. Neither is good nor bad absolutely, but only in relation to the subject and the treatment which the subject is to receive. The Saxon has nerve, terseness and simplicity, it smacks of life and experience, puts small and convenient handles to things, but it has neither height nor breadth for every theme and, to confine ourselves to it, would be an unpardonable impoverishment of speech. Still, for all that, we can and are perhaps allowing the pendulum to swing too far by the current neglect of pure English and Saxon words. They, though not intrinsically yet from association, are more concrete and pictorial than those derived from alien sources, and this is particularly true of many beautiful words we have lost or are in danger of losing. How much more expressive to us is "sand-waste" than "desert"; "mill-race" than "channel": "moonling" than "lunatic"; "water-fright" than "hydrophobia"; "sea-robber" than "pirate"; and "show-holiness" than "hypocrisy." The wearing of woollen clothes does not make a man sheepish; similarly, the reversion to homely words in our daily speech would not make us yokels or clodhoppers. Therefore, why need we neglect and forget them?

Again the modern tendency to make one syllable of two is a further source of linguistic impoverishment and not always with the best result. Surely, *beasts* is no shorter than *beastes* and it is certainly more difficult to speak; the old genitive of "God" was *Goddes* and surely *Goddes grace* is easier to say than "God's grace." Again, apart from the objection that *loves* may be a verb or a noun, *loveth* is a better word than *loves* and *doeth* than *does*. True, we have gained in the case of some words which have escaped the general rules of simplification since *geese*, *mice*, *oxen* and *children* are better than *gooses*, *mouses*, *oxes* and *childs*. For all that, it would be as well if modern English could recover a few more of the older forms as they linger in our perishing dialects, instead of grinding down our speech by careless pronunciation. When we laugh at a countryman for saying *beastes*, we need to remember that he has it in unbroken tradition from the mouth of Chaucer. Our losses may be irretrievable, but before they become greater let us do our best to favour the use and retention of old word-forms and thereby vary the plod of our sentences. Here, I am constrained to stop, as I know that our Editor has definite views as to space; with his permission, perhaps, I may return to this subject on another occasion.

"Think not that strength lies in the big round word,
Or that the brief and plain must needs be weak;
To whom can this be true who once has heard
The cry for help, the tongue that all men speak,
When want or woe or fear is in the throat?

* * * * *

For them that weep, for them that mourn the dead,
For them that laugh, and dance, and clap the hand,
To joy's quick step, as well as grief's slow tread,
The sweet, plain words we learned at first keep time,
And though the theme be sad, or gay, or grand,
With each, with all, these may be made to chime.
In thought, or speech, or song, in prose or rhyme."

THE BREEDING OF *ANOPHELES MACULIPENNIS* MEIGEN IN CAPTIVITY.

By Major C. H. H. HAROLD.
Royal Army Medical Corps.

During the last twenty years or so several attempts have been made by entomologists and malarial epidemiologists to breed anophelines in captivity, and to explain the failures various reasons have been advanced, notably (1) the absence of swarms of males, (2) defective atmospheric humidity in the breeding-room, (3) alterations in the female genitalia induced by captivity, etc., etc.

Although it is not denied that some of these factors may influence results, the experiments recently concluded indicate that their relative importance may require further investigation under different conditions and with other species.

The experiments were commenced in October, 1922, at the Army School of Hygiene, Aldershot. The species of mosquito selected for experiment was *Anopheles maculipennis* Meigen which is fairly easily obtained locally.

General Description of Premises and Fittings.

The breeding-room, an annexe of the Entomological Laboratory, is part of an army hut; it has a wooden floor, double walls and ceiling, lined throughout with tongued and grooved boards, and lighted on the north and south aspects by double windows.

A bench, two feet six inches wide and three feet high, carries the breeding cages, glass tanks and other vessels containing the ova and larvæ.

The cages, made in our own shops, measure 20 inches by 24 inches by 20 inches, the frame is of ½ inch wood, the floor of three-ply wood, the front of glass, the left side, top and back of ordinary mosquito netting; on the right side is an armhole guarded with a sleeve of mosquito netting, below this a door 13 inches by 18 inches which allows ample space for the introduction of a rabbit in a large wire cage. Fouling of the breeding-cage is prevented by a metal tray that fits on the bottom of the wire rabbit cage.

The room is electrically heated by radiators, and regular readings registered by wet and dry bulb thermometers are taken and recorded.

Atmospheric humidity is now solely maintained by evaporation from the surface of the water contained in the large glass tanks in which the larvæ are reared. Smaller vessels filled with water are invariably present in all the cages containing mosquitoes.

Experiment 1.—In the beginning, male and female *A. maculipennis* collected locally were placed in cage No. 1; to these others were added as

found, and an average number of twelve to twenty mosquitoes was maintained. At first there existed an excess of males over females, but, as the life of the male is short and they were less frequently met with as the colder weather approached, the number of females eventually exceeded the males. A rabbit with a partially clipped back was placed in the breeding-cage as a rule every other night, and never more infrequently than twice a week.

It was found that certain females did not take blood from the rabbit, but if an initial feed of banana was provided they did so readily. Latterly it has been the rule to maintain a constant supply of banana in the cages to provide for this contingency and also to supply the males with food. In the later experiments it was seen that recently emerged males and females frequently fed off banana throughout the day.

Although the females in this experiment were taking regular feeds of blood, they failed to oviposit, and one of these was dissected and found to be barren. It was then surmised that the atmospheric humidity might be insufficient, although there were in the room several large glass rectangular tanks, 12 inches by 20 inches by 14 inches, filled with water. Cotton sheets were therefore suspended over the tanks with their ends dipping below the surface of the water which was drawn up by capillary attraction, thus increasing the evaporative area; an increase in the atmospheric humidity was thus obtained, but the mosquitoes continued to die off and fail to oviposit.

The first attempt having proved unsuccessful, it was decided to tackle the problem in a different way.

Experiment 2.—On October 21 fifty female *A. maculipennis* were collected at Sandwich, Kent, and placed in cage 1 on October 22. They were given an initial feed of banana, and took blood from the rabbit on October 23. On October 31 a small batch of ova (fifty or sixty) was laid; these hatched out on November 2, and regular batches of eggs were now removed from the cage. The largest number was obtained between November 6 and 20, and the insects continued to oviposit up to December 14, when the majority had died off. In all twenty-one batches of ova were recovered, several of the batches being so large that they were most probably laid by two or more mosquitoes. Two batches only proved to be unfertile, and they were easily detected on account of their distinctive light colour.

The batches of eggs were transferred by camel-hair brushes from the small vessels in the cage into glass basins, 8½ inches by 3½ inches, filled with fresh tap water, to which a small sprig of aquatic weed had been added. Here they hatched out, and our efforts were concentrated upon keeping this water fresh and free from film by the regular addition of small quantities of fresh water and aeration by means of a ball pipette.

By November 15 most of the larvæ had died of starvation, owing to our misguided efforts to keep the water fresh and clear. Later, large quantities of weed were added to the fresh tap water, and also water from the neigh-

bouring canal and from Camp Farm, a purified sewage effluent discharging into dykes in which numbers of *A. bifurcatus* larvæ were to be found.

The number of larvæ hatched out still continued to diminish, and on occasions fourth instar larvæ were seen apparently devouring their smaller brethren.

The addition of larger quantities of weed, Camp Farm effluent and canal water to the fresh water contained in these relatively small vessels resulted in rapid formation of surface films, which proved fatal to most of the larvæ, despite aeration and the regular addition of fresh water.

Concurrently with these experiments, larvæ of *A. bifurcatus*, usually in the third and fourth instar, had been collected for class demonstration purposes, and it was found that with very little attention they could be brought to the pupal stage in the water in which they had been collected; but, as detailed above, when it came to rearing *A. maculipennis* from the egg it was quite a different matter. We derived consolation for this failure by reading Giles's book on "Gnats or Mosquitoes," in which, on pp. 29 and 30 (when discussing methods of breeding mosquitoes) the following statement occurs: "By means of a simple apparatus of this sort (dish and cover of netting) the life history of the genus *Culex* can be followed out with great ease, but this is by no means equally the case with *Anopheles*, the species of which are very difficult to maintain in captivity, and I have not yet succeeded in rearing any batch from egg to imago."

A very few adults were reared during this period, although many hundreds of first instar larvæ were hatched out. As the management of the adult from the egg-producing point of view appeared satisfactory, it was evident that our efforts in future would have to be directed mainly towards the rearing of the larvæ.

Experiment 3.—On December 20 a third attempt was initiated, and 26 female *A. maculipennis* were obtained from Sandwich. The use of the wet sheets for the purpose of increasing the atmospheric humidity was discontinued, and it was decided that the larvæ should be reared in the large glass rectangular tanks and that the humidity in the breeding room should be maintained solely by natural evaporation from the surface of the water contained in them.

Banana and blood feeds were taken by the anophelines on December 21, and on January 2 the first batch of eggs was removed from the cage, and a succession of batches followed up to February 14. On February 16 and 21 respectively, 15 male and 24 female *A. maculipennis* were brought in from a stable at Tongham. On March 2, 19 and 22 respectively an additional 13, 6 and 6 were found in a dug-out in the Long Valley, and all of these were added to Cage 1.

Regular batches of ova were deposited by these up to March 21, after which date they were neglected and gradually died off: the eggs were placed in the 8-inch by 3½-inch basins as before, allowed to hatch out, and the larvæ then gently poured with the water into the large glass tanks which had been prepared as follows:—

Two or three inches of coarse washed sand from a dry river bed were placed at the bottom of the tank, and a small quantity of sludge from the canal on top. In this water weeds were planted, and, when the tanks were filled with tap water, they commenced to grow. The water was kept free from decomposition by aeration and the syphoning off of small quantities of water and its replacement by fresh.

The larvæ placed in these tanks died of starvation after a few days. More water weed was now placed in the tanks, but on this occasion was allowed to float free on the surface of the water. It was noted that the larvæ did better if a particular weed (*Myosotis palustris*), collected in the neighbouring canal, was used, and more especially if the tanks were beginning to become offensive.

Tanks were now prepared with three inches of washed sand at the bottom, filled with a mixture of canal and tap water, and *M. palustris* in larger quantities was floated on the surface. Young larvæ from the basins were poured into these, and the water was not aerated or changed. The larvæ grew much more quickly and were vigorous, but quite unexpectedly they disappeared. This disappearance was found to be due to the presence of caddis-fly larvæ, beetles, etc., which had been attached to the weed and had been put into the tanks with it.

After this, to avoid the inclusion of natural enemies, the use of the sand at the bottom of the tanks was retained, but tap water solely was used, and the *M. palustris* was carefully picked by hand, bit by bit, and washed under the tap before placing it in the tanks.

On some of the tanks rapidly forming surface films proved fatal to the young larvæ. The syphoning off of a bucket or two of water and its replacement by fresh, combined with aeration with a ball-pipette, was found to be most effective in checking this. On several occasions films were also successfully combated by skimming the surface of the water with blotting paper after driving the larvæ off into the corners, and the changing of a bucket of water completed the cure.

It was observed that in the tanks which had not been affected by the film formation, and also in those from which it had been eliminated by the above measures, a white fungoid growth frequently appeared on the submerged underlying parts of the floating weed, imparting an opalescence to the water. The water later became offensive, myriads of amœbæ appeared in it, and it developed the power of causing rapid decomposition of added weed, which fell to the bottom and was slowly lysed. The addition of further small quantities of weed favoured the continuance of this septic action, and finally the water became most offensive, black in colour, and the pale white fungoid growth on the weed disappeared. This type of water was most favourable to the development and growth of the larvæ.

Such was the condition of Tank No. 3 on February 17, when it was noted that the majority of the contained larvæ were in the 3rd and 4th instar, and much larger and more vigorous than those in Tank No. 1, in

which the water had remained moderately clear. Later an inequality in the bench upon which Tank No. 1 was resting caused it to break.

Many of the larvæ in Tank No. 3 took seven days only from the first instar stage to pupation and were the most rapidly growing larvæ that we had raised. Between February 19 and 28, 350 pupæ were removed from Tank No. 3 and placed in small vessels in a new empty cage, Cage No. 2. Twenty-three pupæ and adults died during the period of emergence, and, of the remainder, eighty-six were females and the rest males. It is apparently a provision of Nature that the males and females are bred out in the ratio of three to one.

The usual supply of banana was provided, the rabbit was placed in the cage, and the females fed readily. No swarming of the males was seen, but towards night considerable movement and buzzing in the cage were observed, both males and females flying vigorously against the cotton netting. The pupæ had been placed in Cage No. 2, and the females fed, as under :—

Date	Number of pupæ added to Cage No. 2.	Remarks
February 19	10	—
,, 21	14	—
,, 22	50	Rabbit in cage. One female fed
,, 23	50	—
,, 24 } ,, 25 }	20	—
,, 26	119	Rabbit in cage. Majority of females fed
,, 27	43	—
and so on		

The first batch of eggs was laid by these, the second generation, on March 5, eight days after the females had noticeably fed. These were fertile and hatched out in due course. On the 12th and 13th, approximately 500 to 800 ova were deposited, and regular batches were removed from Cage No. 2 up to March 26, when it was noted that these mosquitoes had nearly all died off.

On March 16 the third generation larvæ were in the third and fourth instar in Tank No. 2, in which the water was dark and offensive. As they were doing well, a small pellicle of surface film was risked and no change of water was made. An unusually high temperature was registered that evening; on the following morning a thick blanket-like film covered the surface of the water, and all the larvæ were found to be dead with the exception of seven pupæ and six larvæ which were retrieved with a ball pipette after skimming the surface of the water with blotting paper.

These, the third generation pupæ and larvæ, were placed in a small vessel containing water in Cage No. 3. On March 20 the third generation adults had emerged, 7 in all (4 males and 3 females). Later two more larvæ pupated and an additional two males emerged. Total, six males and three females.

These third generation females were not fed for a day or two, as one of the rabbits which are kept for feeding purposes had produced a litter and

the other one had already been in Cage No. 2. They were fed, however, on the third day after emergence. The females took blood and the males were present, but they failed to oviposit and died off.

Experiment 4.—Two new tanks were now prepared, viz., No. 2 which had recently failed, and a new one in lieu of the broken No. 1. These were put up with three inches of washed sand as before and were seeded from the successful Tank No. 3 above by syphoning off into each a bucketful of the black water. They were filled with tap water, and washed and picked *M. palustris* floated on top. To obtain the optimum degree of decomposition, a small quantity of the above weed was crushed in a glass mortar and added to the tanks every other day.

The young larvæ hatched from the ova produced by the first generation adults were added to the tanks. These two tanks did exceedingly well; aeration was not employed, surface films did not develop, and only on one occasion when they became too septic was it found necessary to change a bucket of water.

The water in Tank No. 2 had remained unusually turbid and offensive, and the larvæ in it were very big and vigorous. Between March 18 and 28, 234 pupæ were removed from this tank and placed in the second generation cage, Cage No. 2, which was now practically empty, the majority of the first batch of the second generation adults having oviposited, died off and their offspring lost in Tank No. 2.

On March 29 there were about 200 adults alive in Cage No. 2, and between March 29 and April 6, a further eighty-six pupæ were removed from Tank No. 1 and placed in this cage. As these adults emerged, it was noted that the ones that had been reared in the very turbid and septic Tank No. 2 were the largest bred out up to date, and the batch as a whole offered a marked contrast in size to the majority of our earlier adults, some of the males being bigger than any ever seen by us in the wild state.

This, the second batch of the second generation females, in due course took blood readily, and considerable movement was seen to occur in the cage at night. No swarming of males was seen, but on the night of April 1 a male and female were seen in copulo on the side of the cage.

On April 1, 4 batches of eggs were removed from Cage No. 2, on the 2nd 2, on the 3rd 1, on the 6th 2, on the 7th 2, and so on. On April 6 practically all the recently emerged males had died off.

Cage No. 2 contained 80 females, and as 320 pupæ had been placed in it and all had emerged, the emergence of a 3 to 1 ratio of males to females had recurred. This is the second time that the second generation adults have produced ova in captivity.

Experiment 5.—In the meanwhile two new tanks had been started off in accordance with the methods now evolved. No changes of water were made and no aeration was carried out.

The first pupæ were removed from the tank on April 10 and placed in

Cage No. 3. Pupæ were removed and placed in Cage No. 3, and the rabbit placed in the cage as under:—

Date		Number		Remarks
April 10	..	8 pupæ placed in Cage 3	..	—
,, 11	..	7 ,, ,, ,, ,,	..	—
,, 12	..	5 ,, ,, ,, ,,	..	—
,, 13	..	14 ,, ,, ,, ,,	..	—
,, 14	..	12 ,, ,, ,, ,,	..	Rabbit placed in cage. Females not noticeably fed
,, 15	..	26 ,, ,, ,, ,,	..	—
,, 16	..	19 ,, ,, ,, ,,	..	Rabbit placed in cage. Females noticeably fed
,, 17	..	6 ,, ,, ,, ,,	..	—
,, 18	..	7 ,, ,, ,, ,,	..	Rabbit placed in cage.
,, 19	..	27 ,, ,, ,, ,,	..	—
,, 20	..	12 ,, ,, ,, ,,	..	Rabbit placed in cage
,, 21	..	6 ,, ,, ,, ,,	..	—
,, 22	..	6 ,, ,, ,, ,,	..	Rabbit placed in cage
,, 23	..	46 ,, ,, ,, ,,	..	One batch of eggs removed from cage
,, 24	..	51 ,, ,, ,, ,,	..	Rabbit in cage. Two more batches of eggs removed
,, 25	..	50 ,, ,, ,, ,,	..	A batch of eggs removed
,, 26	..	38 ,, ,, ,, ,,	..	Rabbit in cage. Two more batches of eggs
and so on				

On April 14, the rabbit was placed in Cage No. 3 which contained a few recently emerged third generation adults, but none of the females took a feed of blood. The rabbit was again placed in the cage on the 16th and many of the females fed in bright daylight before 5 p.m. The first batch of eggs was laid eight days after the first apparent feed of blood. These eggs were fertile, and the larvæ from them were added to a freshly prepared tank.

The second generation adults have now been induced to breed, on two occasions the third generation have followed suit, and the experiments have been brought to a successful termination. There seems no bar to the production of any number of generations, provided that the same care and attention are exercised. Possibly the strain of *A. maculipennis* may die out on account of inbreeding or through being reared under such unnatural conditions; but what is most likely to occur is that on some future occasion the tanks may suddenly go off and all the contained larvæ die.

From now onwards one stock cage containing mixed generations will be maintained. This will minimize the work and will provide a sufficient number of mosquitoes for class purposes or for any future experiments that may be attempted.

A chart showing the temperatures and humidity recorded in the breeding room during the performance of these experiments is appended.

POINTS BROUGHT OUT BY THE FOREGOING EXPERIMENTS.

General.—It cannot be said that success can be attributed to any one particular discovery or factor, but rather to careful attention to all details appertaining to insect management.

Given the building, appliances, suitable temperatures and a reasonable degree of humidity, the following routine methods applicable to this species of mosquito in the various stages of its life cycle have been found of value.

The hibernating female.—To this an initial feed of banana and regular feeds of blood appear essential. If the rabbit is placed in the cage less frequently than twice week, egg-production seems to diminish correspondingly.

After the first feed of blood the hibernating female oviposits, as seen in Experiments 2 and 3, on the eighth or twelfth day.

The larva.—A septic and evil smelling tank of water, with an absence of surface film, is most favourable to its growth and development. Useful adjuncts to promote this condition are :—

(*a*) The seeding of new tanks by syphoning into them water from those which have given good results previously.

(*b*) The use of floating *Mysotis palustris* on the water which supplies a large amount of surface food as it slowly decomposes.

(*c*) Regular additions of the above weed in a crushed condition, to maintain septic action in the tank.

(*d*) Details in regard to the combating of surface films are given in full in Experiment 3.

The recently emerged adults :—These emerge in the ratio of three males to one female. Both males and females in the laboratory will feed off banana throughout the day, and females have been observed taking blood from the rabbit at 2 p.m. On one occasion one particular female made repeated attempts to bite one of us from 10 a.m. onwards, and succeeded in gorging herself at 2·30 p.m. in bright sunlight directly in front of a window.

Mating of adults :—Our observations indicate that successful mating depends upon the female obtaining a feed of blood as soon after emergence as possible. To this end, banana should be supplied to the cage to stimulate her appetite and nourish the male. Again, as the life of the male in the heated breeding-room is very brief, a rabbit should be placed in the cage practically every night during the period of emergence and for a few days afterwards. Later on the presence of the rabbit in the cage twice a week will suffice.

Experiment No. 1 demonstrates the futility of placing males and females of different ages in cages together, especially if the numbers are small and a reasonable excess of males over females does not prevail.

At the end of Experiment No. 3 it is seen that recently emerged males

and females of the same age were together in Cage No. 3, but in very small numbers. There existed in the cage an excess of males over females, and, although the females fed on the third day, oviposition did not result.

In the successful experiments numbers of recently emerged males and females were present in the cages, regular feeds of blood were given to the females commencing immediately after their emergence, and oviposition followed.

From these facts it is evident that the keystone to success is the correct management of the larval tanks, whereby numbers of pupæ and adults are produced at the same time.

Ova are produced by the female eight days after the first apparent feed of blood.

In Conclusion.

In the experiments detailed above, it has been found necessary to curtail the accounts of our many failures, and also for the purpose of lucidity to omit the recounting of many expedients and methods which proved valueless; consequently the descriptions do not in any way adequately indicate the immense amount of time and unremitting care which have been expended upon all details in order to evolve a satisfactory routine which will materially lighten our work in the future.

The success which has attended these efforts is in no small measure due to the work of No. 7250499 Corporal J. Taylor, R.A.M.C., who has visited the breeding-room at irregular hours and sacrificed leave in order to assist in the supervision of the minutiæ which the breeding of these anophelines has demanded. Finally, I wish to thank Lieutenant-Colonel N. E. Dunkerton, D.S.O., R.A.M.C., Officer Commanding, Army School of Hygiene, Aldershot, for permission to publish this paper; also the Director of the Royal Botanical Gardens, Kew, for the identification of specimens of weed used.

Temperatures Recorded in the Breeding Room from October, 1922, to April 30. 1923, Inclusive.

Month	Highest maximum	Lowest minimum	Average daily mean temperature	Average at 10 hours		Percentage of humidity
				Dry bulb	Wet bulb	
October ..	86	42	68·5	69	64·5	75·8
November ..	85	52	69·1	73	67	72
December ..	84	52	72·6	72·5	67·5	73·5
January ..	82	52	65·3	69	65	78·5
February ..	89	57	72·8	72·5	66·5	69
March ..	95	60	78·3	76·5	69	65
April	100	60	81	80	70·5	58·3

SENTENTIÆ VAGÆ.

By Major M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

I.

It is interesting to place in two colums alongside each other the official organization of the Medical Service in the Field, as authorized by War Establishments, and the organization which actually existed on the Western Front during the later stages of the war. Here they are:—

Official organization	Example of the organization which actually existed in France
Three field ambulances, one sanitary section. Each field ambulance to form dressing stations and advanced dressing stations as required	Combined bearer divisions, working under "A" ambulance Commander who "runs the front." Horse and motor ambulances pooled
	Tent Division :—
One field ambulance to form a Divisional collecting station	"*A*" *Field Ambulance.*—Furnished advanced dressing station and walking wounded collecting post
	"*B*" *Field Ambulance.*—Detached to Corps. Commander is O.C. Corps main dressing station
	"*C*" *Field Ambulance.*—One subdivision detached to a casualty clearing station. Commander, Serjeant-Major and nucleus of field ambulance with transport (less horse and motor ambulances) "parked" in divisional back area
	One advanced dressing station only. No main dressing station. Sanitary section withdrawn
Nil	*Corps main dressing station (including gas treatment centre), one tent division plus two tent subdivisions
	*Corps walking wounded station, one tent division
	*Corps rest station, one tent division plus one or more tent subdivisions
	†One motor ambulance convoy (proportion of divisional motor ambulances occasionally "pooled" with this unit)
	†Sanitary sections (each allotted an area)
Twelve casualty clearing stations (originally lines of communication units)	Twelve casualty clearing stations each reinforced by tent subdivisions from the divisional field ambulances, and by surgical teams from base hospitals, or other casualty clearing stations
Five motor ambulance convoys	One motor ambulance convoy
Two mobile X-ray units ..	Two mobile X-ray units
Two mobile laboratories ..	Three mobile laboratories
Mobile dental unit	Mobile dental unit
Two advanced depots of medical stores	Two advanced depots of medical stores
	Two or more sanitary sections (remainder detached to corps)

* From field ambulances of divisions in the Corps.
† Detailed from army troops by D.M.S. Army.

II.

A feature of the "official" organization is the complete absence of Corps Medical Units. In this respect the D.D.M.S. of a Corps was unique. A Corps in 1914 consisted of two permanent Divisions and a few corps troops. By 1916, during battle, it had grown to six or more Divisions plus 15,000 Corps troops. Its ration strength might amount to 100,000. The Corps had become by then a framework into which were fitted three or more Divisions in the line, with others resting in the back area. Divisions came and went — they did not belong permanently to the Corps. If Corps were fighting, fresh Divisions arrived—if holding a quiet sector of the front tired Divisions came to refit. The Corps became the principal fighting formation in France.

As regards medical services, in the early days little was required of its D.D.M.S. beyond the co-ordination of evacuation from Divisions to casualty clearing stations, and general sanitary control. Later on, with congested areas and the narrowing down of Divisional fronts, main dressing stations for each Division were impracticable and Corps main dressing stations were established. They were followed by other Corps institutions such as rest stations, walking wounded stations, scabies treatment centres, and the like, staffed by field ambulances detached from the Divisions of the Corps Pooling of field ambulances on the lines of artillery Brigades was never carried out. It was not called for evidently, or it would have been done by Corps Headquarters as a temporary measure. During fighting there were plenty of spare field ambulances in the resting Divisions and it was the exception to employ them extra-divisionally. Many considered that an additional field ambulance should have been allotted to the Corps troops. In view of the above it was probably not required. The casualty clearing stations were not under the administration of D.D.M.S. Corps except in one Army for a short period. The D.D.M.S. of a Corps was not concerned with these units except to see that they did not delay the return of his motor ambulances by tardy unloading.

III.

The three members of the "Hierarchy," the D.M.S. of an Army, the D.D.M.S. of a Corps, and the A.D.M.S. of a Division, resemble a family of three boys with unequally distributed toys. "Dimms" the first born has more than he can play with. Little "Addums" the youngest, inherits some very good, serviceable toys in his own right—the author of War Establishments being his fairy godmother. But "Didums" the second boy, has been forgotten. He has no toys to play with. Naturally he has to beg or borrow. "Dimms" in a generous mood looks around his ample toy cupboard picks out a motor ambulance convoy and tells "Didums" to run away and play with that. But "Didums" soon gets bored and sighs for more toys to play with. As "Dimms" would give him no more he helps himself from

those belonging to little "Addums." Later on, "Dimms" himself takes the sanitary section from "Addums" and gives it to "Didums." "Didums" feels much happier for he is now equipped with toys as a second son ought to be. Poor little "Addums" doesn't quite like the arrangement but what can he do? If he is a well brought up, nice-mannered little boy, as he always is, he listens to the assurances of his elder brothers that it is all for his own good, and runs away and plays with his remaining toys—up in a little trench where his big brothers are not likely to disturb him.

IV.

There was considerable discussion, with little divergence of opinion, regarding the question whether the casualty clearing station should be under the administration of the D.M.S. of an Army or the D.D.M.S. of a Corps. The balance of opinion was strongly in favour of it remaining under the D.M.S. Army. It was felt that a Corps Headquarters was too mobile and therefore liable to move to another area at short notice. The casualty clearing station could not follow, and would thus come under new administration. It might suffer from lack of continuity. Moreover, the handling of ambulance trains could be done only in the office of the D.M.S. Army and the control and co-ordination of evacuation was one of the most important features of casualty clearing station administration. There were many other reasons, both administrative and professional, in support of this opinion.

V.

On the other hand, there was something to be said in favour of the forward line of casualty clearing stations being placed under the D.D.A.M.S. of Corps. To begin with, it is an accepted principle that a limited number of units can be handled by one command. Thus, a Division can handle a limited number of Brigades, and a Brigade a limited number of Battalions. Four Battalions to a Brigade is the usual limit—eight Battalions would be unwieldy. The D.M.S. Army had very important duties to perform in connexion with the general medical organization of the Army.

He was also the responsible adviser on all matters connected with Hygiene, in addition to which he had in his own office the direct administration of twelve casualty clearing stations and several smaller units. The question therefore arises whether one command should have to administer directly so many units, in addition to the general supervision of the whole medical and sanitary services of an army. No Officer in the Army save the D.M.S. was authorized to inspect casualty clearing stations. To visit them frequently was difficult, owing to their distance from his headquarters. Again, armies as a rule "farmed out" the casualty clearing stations, along with other army troops, on the headquarters of corps in whose area they they were located; this led to the curious anomaly of a casualty clearing station being placed under the headquarters of a corps for all services—

supply, ordnance, postal, etc., except medical. The casualty clearing station was connected with, and dependent on every branch of the corps headquarters except the D.D.M.S. It was an anomaly which other branches failed to understand.

VI.

It is possible that under Corps auspices casualty clearing stations could have been moved more rapidly, for Corps were relatively better provided with motor transport than Army Headquarters. Again, a more fluid organization of the forward area could have been obtained. If there were any watertight compartments in the forward area, they were most likely to be found between the casualty clearing stations and the field ambulances. For instance, when a Division or Corps was carrying out a raid or minor operation, it was not always the custom to inform the casualty clearing stations. The first intimation the latter unit might have was the arrival of casualties. This would not happen with the forward medical units and the casualty clearing stations under the same control. Furthermore, the D.D.M.S. Corps was in a position to render much assistance to a casualty clearing station. Being on the spot and in close touch with other services, he could get these services interested and obtain for two casualty clearing stations more equipment and accessories than could be done for twelve by the Army Headquarters. It was not uncommon to find the operating hut of a Corps main dressing station fitted with sinks, wash-basins, glass windows, etc., while the casualty clearing stations had few fittings and linen windows. He could help out a casualty clearing station with additional personnel at short notice. Yet these are but minor advantages. There was this advantage to the force generally and the sick or wounded soldier in particular which could be obtained by placing the casualty clearing station and the forward medical units under the same administrative control. During battle, the main dressing station would then be eliminated and casualties sent direct to the casualty clearing stations; during quiet periods the Corps rest station could be placed *tactically* in rear of the casualty clearing station. Instead of competing against the casualty clearing stations, the Corps rest station could take its lighter cases of sickness and its convalescents when fit for transfer. Any acute case thus got the benefit of casualty clearing station treatment and nursing at an early stage of his disability and he was not "held up" in a forward unit on the off chance of his condition improving. Direct evacuation to casualty clearing station and the transfer of light cases from casualty clearing station to Corps rest station were two features of the tactical employment of medical units which were impracticable with casualty clearing stations under the control of Army Headquarters.

VII.

With two casualty clearing stations under Corps control, the sites of Corps rest stations and other institutions would have been chosen in relation

to the location of casualty clearing stations. In battle, when many Divisions came to the Corps, it would have been possible to establish a definite camp for parked field ambulances, near the casualty clearing station. The venereal convalescents might have returned to duty as bearers and would have been available whenever required. Evacuation by train must be controlled by D.M.S. Army, but this is only in accordance with the principle of one formation controlling the evacuation *to* its units instead of *from* its units. It is perhaps the better system. Various other minor advantages are also apparent. For instance, urgent communication between casualty clearing stations and D.M.S. Army regarding evacuation was done principally by telephone. In battle, the numerous exchanges between a casualty clearing station and Army Headquarters were congested, whereas Corps and Army Headquarters were always in close communication. Also the unnecessary duplication of returns could be avoided by having particulars taken only at the casualty clearing station. (It was obviously a lack of *liaison* to take particulars at the main dressing station and again at the casualty clearing station half an hour later.)

VIII.

During the later stages of trench warfare, the aim and object of the forward medical units was to get the wounded man into the reception room of a casualty clearing station at the earliest possible moment. For the majority of cases little surgical treatment in the forward area was required save adequate splinting and dressing of wounds *once*. Anti-tetanic serum could be given on arrival at the casualty clearing station. Surgery in advance of the casualty clearing station slumped to first-aid work. Thus the main dressing station could be side-tracked so long as the casualty clearing stations were not over-filled. The latter contingency was apt to happen after several days of heavy fighting, and was inevitable owing to many factors beyond medical control. It had to be kept in mind as an awkward situation liable to occur during battle. If the main dressing station was functioning and therefore practically full the situation was critical; but with an empty main dressing station standing by the problem was simplified by switching on to this. The casualty clearing station had then time to recover. Direct evacuation to casualty clearing stations with an empty main dressing station in reserve was a system which had much to recommend it.

IX.

At the beginning of the war the casualty clearing stations, then called "clearing hospitals," were line of communication units. This was in accordance with pre-war conceptions of evacuation. The advent of the motor ambulance, the commencement of trench warfare, and the special conditions of war surgery in France modified these conceptions profoundly. The casualty clearing station became "the pivot upon which the removal of sick and wounded turns" (to quote from Royal Army Medical Corps

training) to a degree which pre-war conceptions never anticipated. Surgically, evacuation had to be "speeded up"—stationary warfare and the presence of motor ambulances rendered "speeding up" possible. Under such conditions it was only natural that the casualty clearing stations should be advanced to Army control. The question arises whether, on account of the long phase of stationary warfare, the comparative emasculation of the forward medical units as regards serious surgical work and the continued "speeding up" of evacuation, the casualty clearing stations might not have been further advanced to Corps control. The "speeding up" of evacuation meant that the average casualty was whisked off in a motor ambulance and deposited in the reception room of a casualty clearing station within an hour or less of his arrival at the advanced dressing station. It was not in the interests of the majority of patients to pass them through the main dressing station; to do so was merely a waste of valuable time at a station which was not able to do anything for them beyond first-aid work. Yet the possibility of trench warfare changing into a war of movement at short notice had to be kept in view since the organization of a vast medical service cannot be changed in a day.

To have remodelled the existing organization so that it catered exclusively for stationary warfare might have spelt disaster in the event of a war of movement recommencing. This possibility, together with the risks attendant upon swapping horses in mid-stream, tended, probably, towards leaving the casualty clearing stations under Army Control. If so, it was playing for safety—a Medical Service in war cannot afford to take risks.

X.

With regard to the rôle of the Corps rest station, if not placed tactically in rear of the casualty clearing station, it was attempting to compete with that unit in order to reduce sick wastage. If working behind the casualty clearing station, it stood in relation to the latter much in the same position as the convalescent depot to the general hospital. It could not play this rôle unless the casualty clearing station was under the administration of the D.D.M.S. Corps. The casualty clearing station, on principle, had to remain empty in case of battle. Under the D.M.S. Army it had no alternative but to evacuate to base. Sick wastage was a cause of much depletion of Divisions, more especially while holding a quiet sector, as no reinforcements could be expected if fighting was taking place elsewhere. Take the case of the individual indispensable non-commissioned officer for example. If his malady could be cured without evacuation to base, he rejoined his Battalion as soon as fit. If evacuated, he passed through general hospital, convalescent depot, and reinforcement depot, and appeared many weeks later at another part of the line in a strange Battalion. His rank may have been acting—the indispensable non-commissioned officer had then sunk during the process to a discontented private. The efficiency value of treating suitable cases in Corps areas was thus very great. There

was a strong motive in the Division, the Corps, and the Army, to retain slighter cases of sickness during quiet periods of trench warfare. It was a motive which deserved serious consideration.

XI.

It was the same motive which caused the birth of the convalescent depot movement. Slight cases were being evacuated to England, and did not return in anything like the numbers in which they were evacuated. There was considerable depletion of the strength of the Expeditionary Force on this account. While the Division or Corps tried to stem the tide of sick wastage by forming rest stations in competition with casualty clearing stations, the Expeditionary Force as a whole was attempting the same task by forming convalescent depots to compete with home. This same motive led one Army to establish an unofficial convalescent depot, formed from its casualty clearing station personnel and tentage, and located within a few miles of the big base convalescent depots. Other formations had similar institutions. The Third Corps established a convalescent depot in 1917, located in the Corps area about 15 miles behind the line. It was in operation until the German advance in 1918. The men were accommodated in Adrian huts and among other features it possessed a sixty-acre farm. So important was the reduction of sick wastage that it might have been worth while to recognize the presence of this strong motive in all formations. The *raison d'être* of an unofficial convalescent depot in any formation was that the patients still belonged to that formation and could be returned to their units direct as soon as they were fit for duty, whereas the official convalescent depots received men who had been struck off the strength of their units, and turned over the discharged men to a base reinforcement depot. Had an official convalescent depot been placed at the disposal of each army the problem of depletion from sick wastage might have been simplified, though not solved. But there were too many reasons against allotting convalescent depots in this manner.

(*To be continued.*)

Clinical and other Notes.

THE TREATMENT OF SUPPURATIVE OTITIS MEDIA AND MASTOIDITIS DUE TO *STREPTOCOCCUS HÆMOLYTICUS* BY VACCINES IN ADDITION TO OPERATION.

By Temporary Captain R. R. LAW.
Royal Army Medical Corps.

Most general surgeons operate on acute mastoiditis following middle ear infection, and will meet with distressing cases from time to time where the pathogenic organism is a *Streptococcus hæmolyticus* and the infection spreads to the lateral sinus, brain or meninges, any one or more of these regions becoming infected. In spite of further drainage operations, lumbar tappings and anti-streptococcic serum, the cases go rapidly to a fatal ending.

Two recent cases of suppurative otitis media and mastoiditis where *S. hæmolyticus* was found in the aural discharge, have been treated with autogenous vaccine in addition to operation. The patients have made good recovery without complications after the mastoid operation.

It is admitted that these cases might have recovered after operation without vaccine treatment, but they were of the type in which infection spreads, and in using the vaccine one felt that assistance was being afforded to the natural powers of resistance.

Of the two cases, both treated on similar lines, the more severe is here reported.

On January 28, 1923, a serjeant of the Royal Engineers, aged 36, reported sick with pain, pyrexia and obstruction in the left ear. No recorded history of previous trouble with either ear. On examination the right ear was practically normal, but the left was found to be plugged throughout with a mass of cerumen and epithelial debris, evidently an accumulation of years. This was removed and, as is common in such cases, a dermatitis of the meatal wall, extending on to the drumhead, was found, which becoming acute causes the pain for which the patient seeks relief. There may be a concomitant hyperæmia of the middle ear in these cases, and if organisms are present which have reached the middle ear by the Eustachian tube it is evident that we have a condition which may develop into acute otitis media.

The treatment adopted in these cases of meatal inflammation is to pack the meatus with ribbon gauze saturated with fifty per cent. alcohol, changing the packing daily. This was done for four days when the meatal inflammation was found to have subsided and the patient was discharged to duty. He was advised never to put soap, water or anything else into his meatus. Soapy water is a septic irritant and of itself may set up a dermatitis of the meatus.

On February 8, 1923, the patient reported sick again having had earache all night; he noticed some discharge on this day. On examination there was a slight serous discharge in the meatus, also redness and swelling of left meatal wall and some inflammation of the drumhead was observed. The swelling of the meatus prevented the whole of the tympanic membrane from being seen, but so far as could be ascertained there was no perforation, and the condition was thought to be a recurrence of the dermatitis.

He was excused duty and the meatus dressed with spirit gauze. During the next two days there was no pain and the parts looked better, but on February 11, 1923, deep pain was complained of and the discharge increased.

February 12, 1923. Admitted to hospital. A perforation in the posterior inferior quadrant could now be seen, and otorrhœa was more free and becoming purulent. He complained of deep pain in the ear radiating over the temporal and mastoid regions. Temperature 102° F. at night. Specimen of aural discharge sent to the bacteriologist who found *S. hæmolyticus* and *Staphylococcus aureus.* Owing to septic teeth, the oral cavity was foul and was treated with hydrogen peroxide.

One cubic centimetre of mixed infection phylacogen (Parke, Davis & Co.) was given hypodermically and repeated on the two following days. This mixed infection phylacogen is a sterile aqueous solution of bacterial derivatives prepared by the culture in approximately equal proportions of a variety of pathogenic organisms including streptococci and staphylococci in artificial media for at least three days, after which the bacteria are killed, 0·5 per cent. of phenol added and the fluid separated by filtration through porcelain.

February 13, 1923. Continued pyrexia, mastoid pain and tenderness, with profuse and offensive otorrhœa. Blood count to-day shows a leucocytosis of 15,000 which points to probable presence of pus in the mastoid.

February 14, 1923. Mastoid operation. Large pneumatic mastoid opened up. Numerous large cells and small antrum. All cells purulent. Low lying middle fossa opened. No purulent collection here and the dura was found healthy. The wound cavity was flooded with 1-2000 flavine, and a drainage tube, reaching to the bony cavity, was inserted, and the upper angle of the wound sutured.

February 15, 1923. Condition satisfactory on the whole. Twenty cubic centimetres of anti-streptococcic serum given.

February 16, 1923. Thirty cubic centimetres of anti-streptococcic serum given to-day. Coarse râles heard all over the chest and a large tube bronchitis, with profuse muco-purulent expectoration, developed, which subsided in five days. Discharge from wound and meatus is foul and copious.

February 17, 1923. Sleeping well and no pain. Temperature coming down. First dose of autogenous streptococcus vaccine given.

February 19, 1923. Discharge still offensive and stains dressings blue. Specimens sent to bacteriologist who found *Bacillus pyocyaneus* of which he made a vaccine and subsequently mixed it with the first vaccine.

February 20, 1923. An urticarial rash appeared on the limbs and trunk which disappeared in thirty-six hours. For a short time the pulse ran up to 136 and the patient felt and looked ill; quin. sulph., calx. lact., rectal salines and brandy were administered. In a few hours the crisis passed and from that time the patient continued to do well.

February 21, 1923. Satisfactory. Wound granulating.

March 2, 1923. Wound healing satisfactorily. Discharge from wound and meatus is free, sweet and tinged green. First dose of new mixed vaccine given to-day.

April 15, 1923. The wound is closed and the middle ear dry with hearing almost normal. There are no signs of any secondary complications.

In such cases as this it is inadvisable to irrigate the mastoid cavity for the first six days after operation for fear of breaking down protective barriers. During this time, it is sufficient, after the first forty-eight hours, to remove the tube daily and gently irrigate the meatus with some mild fluid like 1-2000 flavine, to cleanse the orifice of the wound and re-insert the tube. It is not advisable to use any irritating antiseptic in these cases; 1-2000 flavine has been found useful, but probably saline solution would do as well. Also the patient should be kept recumbent for the first fourteen days after operation, however well he may appear to be.

I wish to thank Major Gibbon for his bacteriological work and notes.

BACTERIOLOGICAL NOTES ON EAR CASES BY MAJOR T. H. GIBBON, O.B.E., R.A.M.C.

Three points in these cases are of special interest to the bacteriologist: first, the organisms causing the trouble, secondly the leucocyte count and, thirdly the use of a vaccine.

Taking the points in sequence: (1) I was struck with the fact that although I did not get streptococci from the ear swabs I found this microbe very frequently in the secondary lesions of fulminating cases dealt with during the past year. The reason of this was not hard to find: the discharge from an ear is as a rule full of organisms of different sorts, the most frequent being *Staphylococcus aureus* and *albus* and a Gram-negative bacillus which is usually found in those cases in which offensive smell is a marked feature, also diphtheroids and *Bacillus pyocyaneus*. Most of these organisms grow more readily than the streptococcus, and consequently smother it on the plates. To overcome this it was necessary to obtain media that was simple and easy to make and on which the streptococci would grow more freely. Several were tried and eventually the hormone agar described by Hiss and Zinsser in their book has been found to meet all requirements. Since using this medium I have found that hæmolytic streptococci can nearly always be isolated from fulminating cases, also that hæmolytic streptococci are to be found in a large proportion of throats, whether healthy or diseased, and the throat undoubtedly is the source from which the middle ear becomes infected.

I have no doubt that the appearance of *B. pyocyaneus* in this case was

due to a latent infection in the ear having been stirred into fresh activity by the operation.

(2) The leucocyte count in these ear cases, and in the secondary abscess formation from them, would appear to be of considerable help. Several counts have been done and in every case of pus formation a rise had been noted of about 12,000 to 20,000 cells. There was one case of streptococcus infection with cerebellar abscess, however, where there was no leucocytosis but on the other hand a leucopenia, and one must always be on the look out for such a case when doing white cell counts.

(3) Lastly the use of vaccine.—If these cases come under observation during a latent period and a streptococcus can be isolated, a vaccine is undoubtedly useful before operation to raise the immunity, but with fulminating cases one does not usually see them till they fulminate and the cause of the fulmination is the infection with hæmolytic streptococci, on the top of an old chronic ear infection with many organisms. In these cases the question of using a vaccine requires careful thought. If the patient shows a good reaction in the shape of leucocytosis and if the operation appears to have cleared out the focus of infection then I think one is justified in giving a small dose tentatively and watching results. On the other hand should the leucocyte response be poor and the temperature high then a vaccine would not be advisable. In the case described by Captain Law the general response was good and a primary dose of about ten million autogenous streptococci was given followed by the same dose four days later. When the *B. pyocyaneus* appeared this was added to a stronger streptococcic vaccine and constituted what Captain Law has called New Vaccine. I am fully convinced that in these streptococcus cases there is not much use in giving a stock streptococcus vaccine, as there are so many varieties of streptococci. I believe in using an autogenous streptococcus, and with a good medium this does not take long to prepare. I think that in these cases autogenous vaccines of streptococci, *B. pyocyaneus* and *S. aureus* do good. On the other hand a vaccine prepared from the Gram-negative bacillus which I have isolated from several of these cases does not appear to have such a good result.

TREATMENT OF A CASE OF DIABETES MELLITUS WITH INSULIN.

By Captain A. G. BIGGAM, O.B.E.
Royal Army Medical Corps.

Private B. received as a transfer from abroad on March 14, 1923, diagnosed diabetes mellitus.

History of present illness.—Commenced about January 24, 1923, when patient suddenly began to feel out of sorts, mouth very dry, great thirst and constipation, frequency of micturition and itching at the point of penis. Sugar was discovered in his urine, also ketone bodies were found to

be present. He was put on a diet consisting of restricted carbohydrates and vegetables.

Condition on admission to this hospital.—Extremely thin and emaciated. weight seven stone, three pounds. Complained of great weakness. No thirst or polyuria. Teeth good, bowels regular. No signs of organic disease of respiratory or cardio-vascular system.

Nervous system: retinæ normal, all deep reflexes difficult to elicit. Knee- and ankle-jerks absent even after reinforcement. There were crops of boils in right axilla, but these rapidly cleared up under treatment. No other septic focus could be discovered.

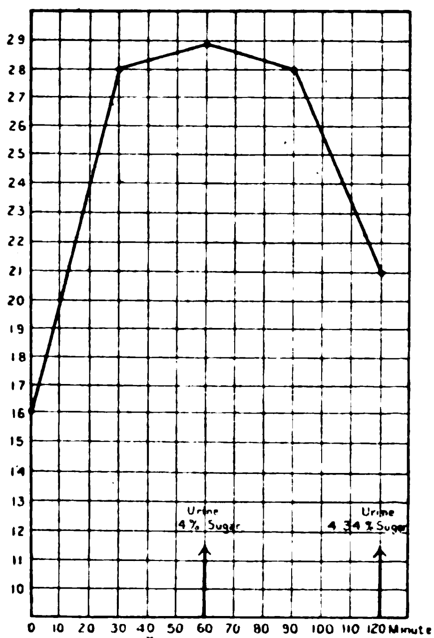


CHART I.—Private B., May 11, 1923. (After 50 grammes glucose.)

Urine on admission showed sugar present in small quantity, also acetone, diacetic acid present in fair amount.

Treatment.—Patient was put to bed and starved for two days; getting only beef tea, coffee and tea. He was then found to be free from sugar and started on a modified Allen's diet and worked up the scale with one fasting day a week till a trace of sugar again appeared in his urine. This occurred when he was having a diet of 750 calories a day. He was ordered two fasting days and worked up from the bottom again until it was found that he could only tolerate a diet consisting of:—

Carbohydrates ...	55	grammes.
Protein	62	,,
Fats	48	,,

Total caloric value 900 calories.

This diet contained no bread at all and any addition of bread immediately caused sugar to appear in the urine. His sugar tolerance was investigated by Maclean's method on various occasions and a few curves are attached showing his reaction to fifty grammes of glucose.

Patient was first ordered insulin on June 13, 1923, initial dose given being ten units at 11 a.m. daily. He was kept on the same diet as he had been able to take, and remain sugar free, without any insulin.

Control examinations of blood sugar were carried out at various hours during the day, and it was found that the blood sugar was kept at a level varying between 0.17 per cent and 0.1 per cent.

Insulin was increased by adding another ten units before supper-making his total quantity twenty units in the day. His blood sugar was now found not to rise above 0·13 per cent nor fall below 0·06 per cent at any time during the day. He frequently showed as low a level as 0·06 per cent, but never felt any ill-effects from this hypoglycæmia.

Insulin administration was discontinued after a seven weeks' course and it was found that the patient could now tolerate a diet consisting of :—

Carbohydrates...	30 grammes.
Protein... ...	68 ,,
Fats	83 ,,

Total caloric value 1,100 calories.

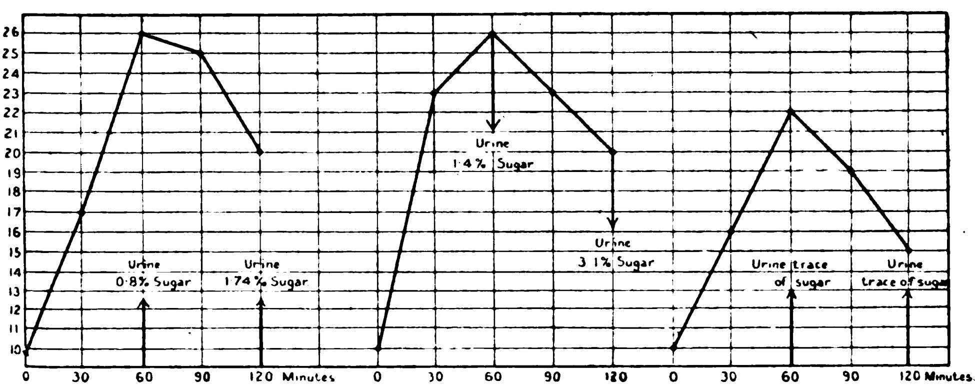


CHART II.—Private B. (after 50 grammes glucose), May 14, 1923.

CHART III.—Private B. (after 50 grammes glucose), June 12, 1923.

CHART IV.—Private B. (after 50 grammes glucose), Aug. 5, 1923. Test carried out one week after stopping a seven weeks' course of insulin treatment (20 units daily).

He still continues able to tolerate this diet and his urine remains free from sugar but occasionally shows a very faint trace of ketone bodies by Rothera's test but not sufficient to cause any reaction to Gerhart's test. His weight is now nine stone four pounds. General condition extremely good. Can take quite a fair amount of walking exercise without fatigue.

Knee- and ankle-jerks now present but not very brisk, retinæ normal. His reaction to fifty grammes of glucose at present is shown in graph No. IV, and indicates a very marked recovery on the part of the pancreas because of rest afforded by insulin administration, the highest point reached being 0·22 per cent sixty minutes after the glucose feed and a fall down to 0·15 per cent sixty minutes later. Thirty grammes of bread can now be taken without causing any rise in blood sugar above normal.

The patient has now recovered so much that he should be able to live a moderately active life, restricting his diet to 1,100 calories and carrying out a fasting day once a week to rest his pancreas. He is not, however, considered fit for retention in the Army.

DISSERTATION ON A NEW DISEASE—DERMATITIS TRICHORRHŒA (TONSORIS).

By Major A. W. HOWLETT.
Royal Army Medical Corps.

At first sight the title might seem to be a declension into the Græco-Roman form of the familiar "barber's rash"; but it is not so. The patient, who I may remark parenthetically, assured me that his was not an uncommon condition in his trade, was a barber on a large ocean liner plying from Southampton on a course which carried him through the zones of the tropics. He presented himself at the termination of one of these voyages with a sub-acutely inflamed hand and forearm. The condition had originated several voyages past and had recrudesced and grown worse with every subsequent passage through the hot belts. There were numerous small discharging sores and the whole hand was tender and swollen. The inflammation was not deep seated; it appeared to affect the superficial skin and fascia only. The glands were not affected.

The singularity of the disease lay in this—that from each sore as it erupted and broke there issued one or more tiny hairs recognizable as stubble from men's beards. My brother, who had the case in hand, told me he had spent hours in the course of several dressings trying to eradicate these stubs, the only method being to apply poultices and try to pick them out piecemeal, but as soon as one place healed they would break out elsewhere. With some amelioration but the hand still unhealed, the man had to go to sea again.

I have emphasized the point that the patient had to traverse the tropics in his voyages because that is an essential condition in the development of the malady. It was while he was shaving his customers in the warm latitudes that the stubble in the lather worked its way into the skin between the fingers, the pores being unduly open by sweating. Probably he had a preternaturally thin skin in this area or else exceptionally patent sweat glands; but according to his own observation, his case, though uncommon, does not seem to be unique.

It is rather illuminative in view of what we know of living parasites that pursue the same courses, that inanimate objects should thus be able to burrow their way into the tissues as if they were endowed with the same motility.

I am indebted to my brother, Dr. L. W. Howlett, of Southampton, for permission to describe the case.

Travel.

ACROSS NORTH-WEST INDIA ON FOOT.

BY CAPTAIN M. J. WHELTON.
Royal Army Medical Corps.

WITH kilts swinging, pipes playing, and in a cloud of blinding dust from hundreds of marching feet, the regiment swung along a seared, waveless plain bathed in brilliant sunshine. Behind the marching men came the baggage party, the bullocks plodding along at about two miles an hour.

The scorched land radiated heat. All nature appeared to be in a swoon. The sisskum trees gave welcome shade for the midday halt, while all around the dry thorny scrub but served to emphasize the barren nature of parts of the Punjab.

Tea was drunk and sandwiches were consumed while the local villagers swarmed round to admire the kilties or gazed with awe on the bagpipes.

Anon a whistle was heard, and the "clip-clop, clip-clop" gradually died away as we moved onwards to the first camp of the many we were to occupy on the march necessary to cover the six hundred miles between Amballa and Landikotal. "Ce n'est que le premier pas qui coûte" may be symbolic of the will-power to start on a journey, but the difficulties of keeping going, although well started, are great.

Being the medical officer attached to the unit, I took more than a passing interest in the transport. At the start it consisted of locally-hired bullock carts, of a type that was ancient when Alexander the Great invaded India. It is slow but reliable, and there is no harness to break. In lieu of a motor ambulance two gharries were allotted. (These are horse-drawn traps and were owned and driven by ex-sepoys.) Before dawn tents were struck and loaded on the carts, and in the afternoon—when the new camp site was reached—the unloading and pitching of tents was completed very quickly.

The cooks went on ahead, so that a hot meal awaited the men on their arrival. The regimental contractor had arranged for a canteen and coffee-shop, as well as a dairy and mineral water factory, to accompany us the whole way, and all were invaluable throughout the march. Later on, when we came into other districts, mule carts and camels were substituted for the bullock carts, the camels at first causing much merriment.

At intervals of from twelve to fifteen miles along that Grand Trunk Road, over which have journeyed so many different units of the Army, are the military camps, which consist of a bare piece of ground, bounded by lime-washed pillars and containing a well. The well becomes the centre of greatest importance from the moment when the local authorities are ordered to make arrangements to draw the water to the surface until the medical officer examines it, and—with the air of a magician—chlorinates the water tanks. The water may be as much as fifty feet from the surface and is drawn thereto in large leather receptacles. The portable water tanks are first filled and then the watering troughs.

Native cooks and "bhisties" arrive and carry away the precious fluid in all sorts of odd utensils. The contractor must needs have a tank of chlorinated water to make his minerals, for practically all the well water throughout India is unfit to be drunk by Europeans until treated chemically. To the well also come the sweltering mules and camels and bullocks, not to mention the officers' chargers. All drink with deep relish, for tramping on dusty highways raises a thirst. Then, with the chattering of the followers, the gurgling of camels, the bellowing of bullocks, and the tap-tap of the mallets on the tent-pegs, the camp is evolved; the bugles sound, and dinner is served.

There were nights of Stygian darkness and nights of brilliant moonshine when one could see for miles over that great land—could see the sisskum trees a-tremble as the wind gently shook the branches. It was a land which seemed to say: "You are the greatest of all conquerors, but you, too, are only here for a moment."

A mere recital of the different towns and cantonments through which we passed would be of small interest to the reader. Suffice it to say that the route was mostly through the Punjab, and that the Indus was crossed at Attock, from which historic place we journeyed through Peshawar and Jamrud to the Khyber Pass. As we marched northwards, gradually climbing, the weather became colder, until, at the later stages, we experienced nights of intense frost, although the days were brilliant.

Much could be written, and has been written, on the many historic places through which we marched, while the immense landscape unfolded itself: its cities and forts, its rivers, its temples, its shrines. An American once said that it is only necessary to go to the bazaars of one city in India, as all the others are alike. Well, the bazaars of Amritsar are quite different from those in Peshawar. Superficially all are alike, inasmuch as they are all equally dirty, the artizans work in full view of passers-by, and in none of them does modern hygiene seem to be a recognized science; but each town has its own characteristics and the inhabitants often differ from each other in race and creed.

Amritsar is a walled-in city, with narrow winding streets, and pervading all is that indescribable smell of the East which the traveller "senses" on first arrival in India, and does not lose till Bombay is left behind by the

ship which bears him home. Originally "founded" by Guru Ram Das in 1574, who excavated a sacred tank which gives the city its name (literally "Pool of Immortality").

Just outside the city is an old Fort, which is now garrisoned by British and Indian Army troops. What Mecca is to the Mahommedans Amritsar City is to the Sikhs; it holds their sacred shrine, The Golden Temple. Various preliminaries have to be gone through by those who desire to visit this, but, having divested myself of shoes, socks, cigarettes and camera, and having next washed my feet at the public fountain, I was then permitted to walk through the gate and descend to the marble road that surrounds the blue lagoon, rising from the waters of which is the famous building. It is connected with the mainland by a marble causeway. The walls of the temple are the same, but inlaid, and the dome is covered with tinsel, not gold.

Inside, devotees were praying with a deep fervour, and someone played Hawaian-like music, while on the polished surface surrounding the waters promenaded swarthy Sikhs, chanting in unison a prayer that was passionately ardent. Truly, an impressive sight, with the tropic sun pouring rays of brilliant light on the dome and its encircling blue waters.

Local political controversies are ever "sur le tapis," affecting rarely the onward march of the Indian Empire—rarely, perhaps, but at times with startling results—witness the riots of 1919.

From Amritsar we proceeded by easy stages to Lahore and thence to Rawal Pindi, seeing en route the marvels accomplished by the huge irrigating systems that have converted desert areas into fertile countries. The canals carry water from the five big rivers of the Punjab (literally the "land of five rivers"), so that nowadays two crops a year are got from land that at one time could produce nothing. In Lahore an Indian who wished to show his knowledge informed me that "Bombay harbour is station for ships like Lahore station is station for trains!"

The Indus was crossed at Attock, and we thereby entered the North-West Frontier Province, where trouble is ever brewing, and where one must needs be ever on the alert. Attock Fort is a building also famous in history and the place was considered to be of much strategic importance in those days when the Russian menace was so much talked of. The country in which we found ourselves was quite different from the Punjab. All around were bleak, bare hills, with here and there small villages, every inhabitant of which is a potential rifle-thief. The capital of this "paradise" is Peshawar—another walled-in city, in which you find a strange medley of races. Thereto come the caravans from central Asia, via the Khyber Pass, bringing the products of Cabul and the beautiful carpets woven by the wild villagers in remote parts of Afghanistan.

We rested for five days in Peshawar cantonment and I took the opportunity of visiting the old Fort and the bazaars, and of calling on the mission hospital. In the bazaars were trans-frontier tribesmen—fierce-eyed

Pathans who mingled with Afghans and Punjabi Mussulmans. And everywhere were carpets, Afghans hawking bundles from dealer to dealer, endeavouring to make good bargains; dealers, in their turn, trying to induce the unsophisticated European to enter their shops and only look at their wares. "You need not buy, sir," they would add, tactfully, to the reluctant. He who draws near is inevitably fleeced by the cunning Oriental.

Vendors of sugar-cane and sweetmeats walked about shouting the price of their wares, while the coppersmiths, squatting at their work in open stalls, dexterously made utensils with the minimum of tools.

Imagine the din, imagine the pandemonium, with the dazzling splendour of the tropical sun on the gaudy-coloured clothes that filled the shops or bedecked the fair sex.

As the city is encircled by hills it forms the natural rendezvous for trans-border tribesmen, and many daring coups are planned and directed from the place.

About twelve miles from Peshawar is Jamrud, the rail-head for the Khyber Pass, which is one of the most important of the five gateways leading to the Indian Empire. Down the Pass have swept generations of fierce invaders—Mahommedans, Afghans and Tartars—and through it, too, has marched part of the army of Alexander the Great. *Sic transit gloria mundi!*

The fort at Jamrud was originally erected by Sikhs, and though built only of mud and stone is important as being symbolic of the military regime that holds sway in these parts. Here, too, is the beginning of the rope railway which supplies the units stationed along the Pass. The rope railway is eighteen miles long and is of inestimable value to those whose "happy" lot it is to live in the wildernesses of the Afghan border.

At dawn the journey through the Pass was begun. The road gradually climbs to Ali Musjid. Bleak hills soar majestically to the sky-line. No tree or shrub relieves the dull monotony of the slaty sheen of the rocks. Along the rope railway are slung supplies for the troops who are stationed farther up the Pass, while on terra firma blasting and tunnelling of the solid rock is in full swing. When completed, the Khyber Railway will link up the extreme end of the Pass with Jamrud, so that in years to come one will be able to travel by rail from Bombay to the Frontier, and then—why then—the romance of the Khyber will have lost half its fascination.

All along the hillsides are picket posts where, day after day, sepoys watch and guard the road to the Plains. The caravans, with their bales of carpets and dried fruits, pass along certain days, and but for this precaution would be raided by the local inhabitants.

So, zigzagging and climbing, with the bare hills all round, we arrived at Ali Musjid—a little oasis in this wild Sahara of misery—a little level area with barbed wire all round the camp-site. Not far away are the ruins of the "residence" of the Khyber Rifles, who now live only in Frontier

history. As the nights were intensely cold a ration of rum was issued—always a welcome event. Even during the night the picket posts are on the *qui vive*, communication between the posts being maintained by lamp signalling.

The last day's march, from Ali Musjid to Landikotal, was begun with enthusiasm—the memory of the many miles already covered was blotted out by the rugged grandeur of the scenery. One saw close at hand the walled-in villages, complete with watch-tower that the tribesmen find necessary in the struggle for existence. Blood feuds account for these extraordinary defensive precautions. Many stories and accounts have been written of the unruly customs that hold sway; suffice it to say that once a blood feud is started between two villages a life must pay for a life, until the young bloods get exhausted or else the elders decide that they must combine to raid the common foe—who is naturally the invader. I have heard of how, with the aid of the Political Officer, two warring tribes had come to an amicable agreement, provided tribe A paid tribe B a sum of fifty rupees. This proposal was duly agreed to and ratified. The money was sent to the mediator—the Political Officer—but the young braves of tribe B attacked and killed those who were actually bringing the money. Needless to say, the trouble began all over again, more lives were lost, and I expect the Political Officer said unmentionable things.

The road through the Pass is excellent, and with the construction of the railway, motor cars and lorries have made their appearance in great numbers. One could almost have imagined oneself to be walking along a Highland road—the kilted soldiers marching to the old Scotch airs, played on the pipes, lending force to the imagination. Verily is it that "transportation means civilization." In years to come we may hope to have an Afridi (the local tribe) stationmaster, with the legend "B.A. (fail)" after his name, the "fail" being in very small and inconspicuous lettering.

By tiffin time (lunch time) we had reached our destination and only blurred memories of the long march remained—blurred memories of the wide, open plains of the Punjab, with herds of black buck gracefully moving out of sight, or of the mighty rivers that drive through that great land: blurred memories because the savage hills and snow-capped Himalayan peaks filled the mental horizon on that last day's march.

After tiffin I went to Landikhana, which is a few miles up the Pass, and is at the actual frontier. There—the place being marked by lime-washed pillars—ends the Indian Empire, and across the road is a placard stating: "It is absolutely forbidden to pass beyond this point." On one side were the Amir's soldiers, and on the other the soldiers of the King.

Close to the camp at Landikotal is the "serai"—a roofless enclosure where rest the caravans to and from Peshawar. Owing to the natural inclinations of the Afridis who live in the villages already referred to, a kind-hearted Government has erected these buildings, and has them guarded by locally-raised police (Khussidari). These police are armed with antique types of rifles. "Set a thief to catch a thief!"

I went into the building with a view to seeing the Afghan at close quarters, and found a "caravan" to consist of over a hundred camels, with as many donkeys. Strapped on to the camels are huge bales of carpets, or wicker baskets containing dried fruits—all products of Afghanistan. The camels are long-haired and shaggy—much finer-looking animals than their Indian confrères. The men are tall, broad-shouldered and healthy-looking; dark-eyed, dark-haired, with pink cheeks and a light complexion. The older men sat round small fires made from camel-dung, and drank tea while the young men and boys took the animals to water. A bitterly cold wind was blowing from the mountains and they wrapped themselves in coarse blankets and huddled round the fires, which were emitting an acrid smoke. There is no wood in these parts, hence camel-dung is used, of necessity, for fuel—just as Tibetans use yak-dung for all heating and domestic purposes.

One of the more enterprising among them tried to sell me a carpet, but, having a good idea of the value, I did not come to terms, as he wanted an exhorbitant price. They are reluctant to sell until they get to Peshawar unless they make a very good bargain. Calculations are made in twenty, or parts of twenty.

Next morning, at nine, I started to march from Landikotal to the rail-head with the regiment we had relieved.

We entrained at Jamrud and accomplished in forty hours what had taken two months on foot. Gazing out of the window, I saw familiar camps and well-remembered landmarks, for the train runs close to the Grand Trunk Road all the way. The immensity of the country is not realized in a train journey, and the beauty of the landscape is lost. Wherever we march throughout this land of ancient civilization one sees old palaces, forts and cities, some of which at one time excited the wonder and cupidity of the East. How we have come to be the guardians of this country of over three hundred million inhabitants is one of the strange episodes of history, and the perusal of various expeditions in the days of the John Company (East India Company) is like the reading of a fairy tale.

How much was accomplished by the pioneers anyone who has lived in India will readily admit, and to feel how they felt, one must walk or ride along those roads that run through the wide plains of Hindoostan.

Current Literature.

Syphilis:[1] ÆTIOLOGY.—Klauder discusses the influence of *trauma* in the development of syphilitic lesions. This is an important question from the medico-legal point of view, especially as regards the Workmen's Compensation Act and soldiers' pensions. As examples of syphilitic lesions excited by trauma, he cites mucous patches and glossitis in smokers, condylomata from the irritation of secretions, squamous syphilides in the palms of manual workers, gumma of the frontal bone in Mohammedans from the practice of striking the forehead during religious worship, gumma of the testicle after injury, syphilitic lesions following war wounds (Gougerot and Clara), and aortic aneurysm after contusion of the chest (Ramond and Postina).

SYMPTOMATOLOGY.—Chiray and Coury remark that the old idea of syphilis being a non-febrile disease must be abandoned. They divide *febrile syphilis* into two categories—one due to syphilis, the other to treatment. The best-known form of syphilitic fever is that described long ago by Fournier as occurring in the secondary stage during the outbreak of cutaneous and mucous syphilides. Chiray and Coury point out that it may also occur with visceral syphilis, and may then obscure the diagnosis. The pyrexia is generally continuous, but may be intermittent, suggesting malaria, or irregular, suggesting typhoid. In primary syphilis, fever is liable to occur in the case of tonsillar or buccal chancres, and is then due to secondary infection; but it may also occur with genital chancres in the absence of secondary infection. In the tertiary period fever is generally associated with visceral syphilis, especially of the liver. Sometimes the fever appears before there are any clinical signs of hepatic syphilis, and may be mistaken for tubercle, malaria, or hydatid cyst. In such cases the syphilis is probably latent. In this way syphilis may be responsible for some cases of perihepatitis, supposed to be tuberculous; or of cholecystitis secondary to gumma of the liver, supposed to be due to gall-stones. Bialocour also draws attention to tertiary syphilitic fever, especially among residents in the tropics affected with malaria and dysentery. In cerebrospinal syphilis, fever is most common in early meningitis, but may also occur in later stages. It has been noted in epileptic and apoplectic attacks, in the gastric crises of tabes, and even in general paralysis. In pulmonary syphilis there is sometimes fever, but this may be due to concomitant tuberculosis. Syphilitic pleurisy with fever may, however, occur. The chief characteristic of syphilitic fever is its resistance to antipyretics and its rapid subsidence under antisyphilitic treatment. Hence the importance of the therapeutic test.

In fever of therapeutic origin the authors distinguish that following

[1] Reprinted, in part, with permission from *Medical Science, Abstracts and Reviews*, vol. viii, No. 2, May 1923.

the first injection, and that repeated after several injections. It is more common with arsenical treatment. Pyrexia, after the first injection, may be early or late; the former appears in a few hours (Herxheimer reaction); the latter appears after three or four days, is more severe and accompanied by nausea, vomiting, diarrhœa, or nitritoid crises, and is a sign of hypersensibility to arsenic. Fever repeated after several injections is also accompanied by the above symptoms, and is a sign of intolerance to arsenic.

Galloway thinks that *gastric syphilis* is more common than is generally supposed, at any rate in the tropics and among Asiatics. It may assume one of three types: subacute gastritis, a type simulating gastric ulcer, and a type simulating malignant disease. The first type is the most common (in Asiatics), and the symptoms are those of gastric catarrh, marked anorexia, pain, enlarged liver, and cachexia. A test-meal shows hypochlorhydria. No treatment except antisyphilitic has any effect. In the type simulating gastric ulcer there is a palpable thickening in the epigastrium, vomiting, and hæmatemesis. The differential diagnosis depends on the following points: in gastric ulcer the pain is more localized, and is relieved by vomiting; in syphilitic gastritis the pain is less acute, more constant, radiates laterally, and is increased by vomiting. The type simulating malignant disease is less common. In this there is a tumour and sometimes dilatation of the stomach. The pain is less acute and more constant than that of malignant disease. The condition is a grave one, and, if untreated, probably ends in the same way as malignant disease. Galloway gives details of four cases; one of syphilitic gastric catarrh, one simulating gastric ulcer, and two with tumour, which were originally diagnosed as cancer of the pylorus and cancer of the pancreas or stomach respectively. The two latter cases were cured by mercurial treatment, one of the others by mercury and neosalvarsan, and the fourth case by neosalvarsan.

Stobie reviews the literature of *cardiac syphilis* and adds his own experience. In five cases at autopsy the lesions found were gumma of the endocardium, fibrosis of the myocardium, aneurysmal dilatation of the heart-wall, thickening of endocardium and coronary artery, and pericardial effusion containing spirochætes. Clinically, in 18 cases of aortic disease there was evidence of syphilis or a positive Wassermann reaction, or both, in 13 (70 per cent); in 15 cases of mitral stenosis, 3 gave a positive reaction and a history of syphilis; in 16 cases of mitral regurgitation there was no evidence of syphilis, and all gave negative reactions; 4 cases of myocarditis, with no valve lesions, gave a positive reaction and had evidence of old syphilis. No signs of cardiac disease were found in primary syphilis, but in one case of secondary syphilis there was præcordial pain and extra-systoles, which were improved by antisyphilitic treatment. The chief symptoms noted in cardiac syphilis were anginal and syncopal attacks, præcordial pain, and shortness of breath. The chief clinical signs were cardiac enlargement, extra-systoles, arrythmia, tachycardia, a systolic

apical murmur, a mild degree of the Stokes-Adams' syndrome, and alternation of the heart.

According to Audry and Nanta, *arterial hypertension* is common in syphilitics, especially about the fiftieth year. It may be due to cardiac, vascular, renal, or suprarenal lesions. The authors recommend intravenous injections of novarsenobenzol in courses of six injections of 0·30 to 0·6 gramme. Caution is necessary if the kidneys are affected. The same view is held by Thom, who reports fifty cases of high blood-pressure in persons with a strongly positive Wassermann reaction, but no other symptoms of syphilis.

Eason lays stress on the general failure of textbooks to emphasize the severity of *anæmia* which may be encountered in secondary syphilis. In some of his own cases the red cells were "about 1,000,000," and the hæmoglobin twenty per cent, and many qualitative changes were present. The other chief varieties of syphilitic anæmia are those with splenomegaly and paroxysmal hæmoglobinuria.

Klauder and Kolmer have examined the *urine in syphilis*. They found traces of albumin in 3 out of 43 cases of primary syphilis, and in 4 out of 46 cases of secondary syphilis, all untreated. In two cases there were red cells and granular casts, which cleared up under arsenical treatment. These observers confirm the general opinion that mercury is more toxic for the kidney than arsenic. Mercury, they remark, alters the renal epithelium and hinders the elimination of arsenic. Hence they hold that intensive mixed treatment is wrong. In sixty patients, with a positive Wassermann reaction in the blood, two only gave a positive reaction in the urine. Frequent errors are due to the anticomplementary power of the urine, which is subject to variation. In florid syphilis *S. pallidum* was found in the urine in some cases. They conclude that urinary tests are of no value in the diagnosis of syphilis.

Lakaye has found *S. pallidum in the semen* in five out of twenty-two cases of active secondary syphilis. The semen was obtained by massage of the seminal vesicles. The spirochætes were very sparse, generally free, but occasionally attached to the spermatozoa. Inoculation of the anterior chamber of the eye of rabbits with the twenty-two specimens of semen gave rise to keratitis in nine cases. Lakaye thinks it not impossible that the spirochæte can enter the head of the spermatozoon, or, at any rate, become attached to it, and thus be conveyed to the ovum.

Thompson remarks that *syphilitic spondylitis*, although rare, should be borne in mind in cases of persistent backache. He reports two cases, one in a woman aged 59, the other in a man aged 38. In both cases there was rigidity of the lumbar and lower dorsal vertebræ and tenderness on percussion. In the first case a skiagram showed thickening of the periosteum and bony deposits about the last three dorsal vertebræ, but in the second case the skiagram was negative. In both cases the Wassermann reaction was strongly positive. Under antisyphilitic treatment the backache entirely disappeared.

Mestchersky has observed the *influence of typhus and typhoid infections on concomitant syphilis.* In four cases of secondary syphilis which contracted typhus there was no change clinically or serologically. In three cases of latent tertiary syphilis with a positive Wassermann reaction, however, the reaction became negative during the new infection, and remained so for several years. Two of these were infected with typhus, and one with typhoid. He attributes this result to the effect of high temperature, and mentions that the disappearance of syphilitic symptoms during superadded acute infections with high temperatures was noted long ago by Fournier and Mauriac. Metchnikoff and Roux showed the sensitiveness of *S. pallidum* to heat, and more recently Weichlorodt and Jahnel demonstrated the effect of high blood temperature in the experimental syphilis of rabbits. The author is of opinion that high temperatures may have, not only a temporary, but a permanently destructive effect on *S. pallidum.*

DIAGNOSIS.—Broeman draws attention to the *discrepancies between the Wassermann reaction and the clinical evidence,* and also to the frequent variations in the reports from different laboratories on the same specimen. From an experience based on the results of 1,700 examinations he concludes that a reaction of plus 2 with any antigen is not sufficient evidence of syphilis when the history and clinical signs are negative. As regards cholesterin antigen, he does not accept even a plus 4 reaction as conclusive of syphilis in the absence of history and clinical signs, and mentions several cases in which a plus 4 reaction was given by cholesterin antigen, while with other antigens the reaction was negative, and clinical evidence of syphilis was absent. On the other hand, he found that many cases had negative Wassermann reports when, according to the clinical history and therapeutic test, they should have been positive.

Kolmer describes a *quantitative complement-fixation* test based on the results of his recent work on standardization of the Wassermann reaction, which has been described in a long series of articles in the *American Journal of Syphilis* (1920 to 1922).

Strickler, discussing the *clinical significance of the Wassermann reaction,* remarks that much harm has resulted from relying too much on this reaction. Regarding the influence of drugs on the reaction, he mentions that Ravaut obtained a positive reaction in 5 out of 14 cases of non-syphilitic dermatoses after treatment by arsenobenzene, and that he himself obtained the same result in 16 out of 24 similar cases, the reaction being negative before treatment (see *Medical Science,* 1921, v, 25). He has since tried the effect of intravenous injections of mercury benzoate in twelve cases of psoriasis, lichen planus, and sycosis. In these cases there was no change from negative to positive. Also, in eleven non-syphilitic dermatoses treated with intravenous injections of cacodylate of soda, the arsenic content of which was equal to that of arsphenamine, all but one remained negative. The effect on the reaction, therefore, appears to be due to arsenobenzene. Concerning the occurrence of a positive Wassermann reaction in non-

syphilitic conditions, Strickler mentions that, besides leprosy and yaws, there are other diseases and temporary changes from the normal which may give a positive reaction. For instance, the effect of malnutrition and lipoidal disturbance has been shown by Williams, who found a positive reaction in sixteen diabetics, the reaction becoming attenuated as nutrition was improved by treatment. According to Williams, patients with severe malnutrition caused by diabetes often have an increase of lipoids and cholesterin in the blood which give rise to a positive reaction. The great variability of the reaction in these cases, in the absence of antisyphilitic treatment, is against the assumption of syphilitic diabetes. Strickler remarks that several observers have found a positive reaction during the high temperature of pneumonia and typhus. In ninety-two cases of typhus with no evidence of syphilis, Bauer found a positive reaction during the fever. Positive reactions have also been noted after injury or destruction of organs rich in lipoids; for instance, by cancer of the liver, and tumours of the brain and cord. In pregnant women also a cholesterin antigen may give rise to a positive reaction in a non-syphilitic woman, which disappears after pregnancy (Strühmer and Dreyer). Strickler concludes that conditions other than syphilis may at times modify the blood-serum in the same way as syphilis and give rise to a positive Wassermann reaction.

This question is also reviewed by Kilduffe, who mentions the observations of Thaysen showing that wide variations occur in the Wassermann reaction from time to time without any discoverable cause.

Parthasarathy and Barratt have compared the *Sachs-Georgi and the Wassermann tests* in 265 cases. For the former test two antigens were used, D and L, the first being that employed by Dreyer and Ward (*Lancet*, 1921, i, 956), the second being an alcoholic extract of guinea-pig's heart with 1 in 10 of a 1 per cent solution of cholesterin. For the Wassermann test a 1 in 90 dilution of 5 parts alcoholic extract of guinea-pig's heart with 4 parts of 1 per cent cholesterin was used. The total number of discrepancies between the results of the two tests was 4·1 per cent with L and 8·6 per cent with D antigen. The majority of these corresponded to partial or slight Wassermann positives. Only three serums gave positive results with both D and L antigens when the Wassermann test was negative, and all these gave only "a trace of flocculation." The authors point out, however, that these discrepancy percentages must only be regarded as a provisional measure of efficiency, and that the ultimate interpretation must lie with the clinician. As Dreyer and Ward have suggested, the flocculation test may prove to fit in with the clinical facts better than the Wassermann reaction. So far the two tests agree in the great majority of cases, and there is reason to expect that the simpler one may become the routine test for syphilis.

Cornwall gives his experience with the *Vernes reaction*. Vernes, in 1910, devised a colorimetric scale to estimate the different degrees of hæmolysis, complete hæmolysis being indicated by 8 and absence of hæmo-

lysis by 0. As this was found to be subject to variations according to the different techniques of the Wassermann reaction, and as the rôle of the antigen appeared to depend on the capacity or non-capacity of producing flocculation in the presence of blood-serum, a property possessed by all colloidal suspensions and depending on the size of the colloidal molecules, Vernes changed his colorimetric scale to a diaphanometric one. For this purpose he used fresh horse heart prepared by successive distillations with perchloride of ethylene and alcohol, which he named perethynol. By sufficient concentration of this preparation in distilled water, and by proper adjustment of the relative quantities of this suspension and human serum, the flocculent action of human serum may be appreciated directly, by comparing the turbidity with a diaphanometric scale utilizing the turbidity obtained by a mixture of water and tincture of benzoin. The degree of flocculation may also be estimated indirectly by utilizing the interrelation of flocculation and hæmolysis. For this purpose red cells and an animal serum capable of hæmolysing them are used. The serum must also have the property of opposing flocculation. Pig's serum, which is hæmolytic for sheep's cells, was found to fulfil these requirements. Its hæmolytic power diminishes in direct proportion to the utilization of its antiflocculent power. Hence, the degree of hæmolysis is an index of the antiflocculent property utilized to overcome the flocculent property of the human serum examined. The index so determined is called the syphilitic index, and indicates the flocculent property of the blood-serum examined, which varies directly with the syphilitic substance present in the serum. Periodic determinations of this index indicate the progression or retrogression of syphilitic infection. The direct and indirect methods of measuring the flocculent properties of syphilitic serum are based on the same principle, but the indirect method is more precise. As regards results, Cornwall found that in cases of syphilis under treatment the Vernes reaction with the spinal fluid (130 cases) gave about twelve per cent more positives than the Wassermann reaction, but that the latter gave about nineteen per cent more positives than the Vernes reaction with the blood (232 cases). He points out that the Vernes reaction is not a modification of the Wassermann reaction, but it may depend upon the same colloidal phenomena. Its technique is capable of more uniform regulation than that of the Wassermann reaction. Its value is not to be judged by comparison with the latter, but by correlation with clinical and pathological observation.

Klauder and Kolmer (2) have tried the effect of *fluid from chancres* in the Wassermann test. From experiments with the secretions from syphilitic lesions, they find evidence of a local formation of complement-fixing antibodies, and that the Wassermann reaction performed with such secretions may be of value in differential diagnosis. In the case of chancres, this procedure may be useful when dark-ground examination for spirochætes is negative and the Wassermann reaction in the blood is not yet positive. In fourteen chancres they tested in this way there were three

in which both these tests were negative, but the Wassermann reaction with the chancre fluid was strongly positive. The dates of these chancres were 1, 5, and 7 weeks. The only difficulty is that of obtaining enough fluid for the test, but the authors suggest that the quantity may be increased by making the chancre bleed, in which case both local and general complement-fixing antibodies would be present.

Fuentes states that in the exudate from syphilitic chancres there is one substance which acts as antigen and another as amboceptor in the Wassermann reaction.

PROPHYLAXIS.—Dr. Karl Marcus gives the following Swedish experiences: For some years personal prophylaxis has been compulsory in the Swedish navy, being most strictly enforced in foreign ports. During the cruise abroad in 1913-14 of the 'Fylgia,' 1,000 prophylactic treatments were given, and of the two men who developed venereal disease, one had not carried out prophylactic treatment. In the period 1919-20, 557 men were given prophylactic treatment and only thirteen contracted venereal disease, and in no case was this disease syphilis.

In this connexion Marcus points out that, owing to the commercial blockade in these last two years, the importation of mechanical devices (condoms) was greatly reduced, and he argues that the value of the antivenereal disease properties of these devices far outweighs their contraceptive properties.

Marcus advocates the more general use of the condom, with which, from the antivenereal disease point of view, he is more satisfied than with disinfectants. He appears to use the term "personal prophylaxis" for precautions taken after, as well as before, coitus.

Queyrat (1), after experimenting with several drugs on the living *Spironema pallidum*, found that a 1 in 1,000 solution of *cyanide of mercury* killed them rapidly. He, therefore, recommends this solution as a prophylactic in preference to calomel ointment, more especially as it can be used for disinfecting the mouth. He points out that calomel is insoluble, and he found that the spirochætes in chancres were not destroyed even after morning and evening applications of calomel ointment for five days. They were destroyed, however, both by sublimate and cyanide solutions. A solution of arsenobenzene did not kill them unless a piece of liver was added, as discovered bv Levaditi.

TREATMENT.—In his reflections on the treatment of syphilis, Brocq raises the question whether the direct introduction into the blood of a toxic drug, such as arsenobenzol, may not damage the cells of the body, and after prolonged administration cause permanent changes leading to future degeneration and the creation of *loci minoris resistentiæ* open to damage by subsequent infections and morbid processes. In support of this hypothesis he adduces post-arsenical icterus, which he considers to be arsenical and not syphilitic in the majority of instances. If the icterus is syphilitic, we must, he remarks, assume that previous intravenous injections have

created a *locus minoris resistentiæ* in the liver, vulnerable to *S. pallidum.* Icterus of purely syphilitic nature is curable by further doses of arseno-benzol, but the latter is to be avoided in post-arsenical icterus. Hepatic tissue thus damaged by arsenic may be vulnerable to other infections. Brocq does not, however, advise the abandonment of the modern treatment of syphilis on this account, but urges more prudence in its administration. Discussing the relative merits of intravenous and intramuscular injection, he points out that neither method is precise, and that in the case of intra-venous injection we do not know how much of the drug acts as an anti-syphilitic, because it is so rapidly excreted.

Choice of preparation, in Brocq's opinion, is as important as dosage and mode of administration. He concludes that the treatment of syphilis cannot yet be codified; but, until intramuscular injections of arsenobenzol have been proved as efficacious as intravenous in the early sterilization of syphilis, the latter method should still be used in the early stages; for the later courses the intramuscular method should be preferred.

The limitations of *intravenous medication* in general are discussed by Voegtlin, who points out that this method was adopted in the case of salvarsan to avoid the pain and local reaction of intramuscular injections, not for any supposed increase in the therapeutic effect. According to Voegtlin, there is evidence to show that the equilibrium between the blood and the tissues may be temporarily upset by intravenous medication, and this disturbance may cause unpleasant symptoms and even death. He concludes that intravenous medication is of limited value, and that as a general rule it should be supplanted by the subcutaneous method.

(*To be continued.*)

Reviews.

A TEXTBOOK OF PHARMACOLOGY AND THERAPEUTICS. By E. Poulsson. Professor of Pharmacology in the University of Christiania. English Edition edited by W. E. Dixon, M.A., M.D., F.R.S. London: William Heinemann, Ltd., 1923. Pp. xi. and 519. Price 20s. net.

As pointed out by Professor Dixon in his introduction, Professor Poulsson's Pharmacology is a standard work throughout Scandinavian countries and Germany. "Science is essentially international, and the description of the action of drugs given here does not differ materially from that of other textbooks of pharmacology, except in certain of the explanations and hypotheses, which but serve to show something of the personality of the author and afford an insight into the Continental atmosphere. Those portions of the work which deal with therapeutics form, in my opinion, the outstanding feature."

The classification of drugs adopted by the author follows in the main

the pharmacological system developed by Schwiedeberg. As opposed to a therapeutic classification there is much to be said for a natural grouping of remedies according to their characteristic effects. It admits of new substances being easily classified and their position remaining unaltered by changing therapeutic uses.

The drugs are divided into the following principal sections:—

(1) Organic remedies acting specifically after absorption.
(2) Organic remedies acting locally.
(3) Salts of higher metals, alkalies, acids, halogens, oxidizing media, etc.
(4) Heavy metals.
(5) Ferments and foodstuffs.
(6) Antitoxins and bacterial products.

As an example of the working of this system, adrenalin and pituitrin are placed alongside ergot in Section 1, while thyroid gland, by virtue of its active principle and its action on metabolism, is placed alongside iodine in Section 3.

In an addendum following the latter organotherapy as a whole is discussed in a somewhat trenchant manner. In condensed and well written paragraphs the scantiness of the knowledge on which organotherapy is based, is laid bare, and the dividing line between such as have undergone the test of physiological experiment and "all sorts of mystic productions" is laid down in no uncertain fashion.

As exemplifying some of the small differences in Continental usage, we may note the greater emphasis on the use of camphor as a cardiac and respiratory stimulant and in pneumonia "not only as a stimulant but also on the assumption of a specific action on the disease. . ." Considerable space is given to the antipyonic group, and though their depressant action on the heart is recognized these substances appear to be more extensively used than in this country. While reference is made to the use of tartar emetic in bilharziosis and in leprosy, its important and specific action in leishmaniasis is not mentioned.

The new treatment of syphilis with bismuth and of diabetes with insulin are mentioned in an appendix at the end.

The British and American pharmacopœial preparations and doses are conveniently arranged under each drug.

Written in attractive style the book makes excellent reading and is well worth perusal. J. C. K.

LABORATORY STUDIES IN TROPICAL MEDICINE. By G. W. Daniels and H. B. Newham. Fifth Edition. London: Bale, Sons and Danielsson. Pp. lxiii and 576. 25s.

The reader lays down the volume with a feeling of disappointment that so much good material has not ensured a better result. In parts the book needs expansion; in others, compression; and in many places, correction. Expansion, as on page 226, for example, where the student is informed that the Infusoria comprise the Orders Heterotricha and

Holotricha without any definition or explanation of these groups. Compression, by cutting out much needless repetition. And correction, *inter alia*, to ensure that terminology is used throughout with the same significance. Thus, the "Culicinæ" of one part may represent the "Culicini" of another, or the "Culicidæ" of a third. Obsolete and incorrect names like *Filaria* "*nocturna*," "*Pulex*" *cheopis*, *Ctenocephalus* "*serraticeps*," *Pediculus* "*vestimenti*," crop up to confuse the learner who probably considers even the correct nomenclature a burden too grievous to be borne.

To the reviewer, this edition appears to have been hastily prepared for the press, and insufficiently revised. Alterations in one section are not always followed throughout, with a result bewildering to the beginner. These shortcomings are the more disappointing because the book includes a mass of helpful information and so very easily could have been rendered infinitely more valuable.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subcriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to The Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W. 1.

VOL. XLI. NOVEMBER, 1923. No. 5.

Journal
of the
Royal Army Medical Corps.

Original Communications.

ON LABORATORY DIAGNOSIS IN THE TROPICS AND SUB-TROPICS IN WAR TIME.

BY PHILIP MANSON-BAHR.

THE author of this paper offers this contribution to the organization of the medical services in war-time only after considerable deliberation and introspection. In making these suggestions he wishes to point out that he has had no regular Army training, nor does he profess to have any special knowledge of Army organization. He may claim, however, to have gained some practical experience in the application of modern medical methods in various departments of the Army Medical Service as a regimental medical officer, in charge of medical wards in military hospitals, as a medical specialist and, finally, as bacteriologist and pathologist in military laboratories.

These experiences were gained during the late war in the Mediterranean and Egyptian Expeditionary Forces, and chiefly concern the principles upon which the diagnosis and treatment of the acute epidemic diseases of this region rest; it may be said, however, that they are applicable in the main to campaigns in tropical and sub-tropical countries where these diseases are rife.

The experiences of the last war amply demonstrated the potentialities of the two main diseases—malaria and dysentery—as a cause of casualty and invalidism. The principles suggested rest upon the generally accepted view that a scientific diagnosis, by means of the microscope and other laboratory tests, is most easily and accurately made during the early stages of epidemic disease, so that the specific treatment for that infection may be applied at the earliest possible moment at a time when these measures are most effective.

In order to get the best results, our aim, in so far as is possible, should be "early and accurate primary diagnosis and early and efficient treatment."

In countries where malaria and dysentery are rife, as they are in the majority of tropical and sub-tropical countries, the primary diagnosis for many reasons becomes all important. Time is an essential factor, not only in making the diagnosis, but also in instituting treatment.

Let us examine and see how far this principle affects the main units of the medical services, commencing with the most advanced units and working backwards to the base.

Regimental Medical Officer.

The aim of this officer, as far as I understand it, is to serve the commanding officer of his regiment to the best of his ability by so conserving the health of his men as to keep the maximum number in the firing line. It is to his interest that the exact nature of any prevailing illness should be recognized at the earliest possible moment, so that he may take measures, in so far as lies in his power, to prevent its spread. The means of making this accurate and scientific diagnosis should be made as accessible to him as is possible, so that it should be feasible, under ideal conditions, for him to obtain reports upon blood slides, etc., within a few hours of his morning sick-parade. If he is provided with a competent orderly who is himself capable of making satisfactory blood-films, and who is trained to understand the elements of microscopic diagnosis, the working of this system is by no means impossible of accomplishment, as I hope to explain. When a system makes it impossible for the regimental medical officer to obtain this very essential information within a reasonable period of time, it not infrequently happened in the late war that an accurate diagnosis—say of a fever or flux—was not made, or even attempted, till the sick man had reached the base, it might be 200 miles away. It was therefore impossible for the regimental medical officer to be in possession of details for several weeks after, possibly not even when the man had returned to his unit after a period of convalescence, or possibly after his death. On account of their liability to relapse, this especially applies to the two important epidemic diseases—malaria and dysentery.

The Field Ambulance.

The work of the field ambulance is mainly directed towards the surgical aspect of disease and dealing with emergencies, especially during active hostilities. It will, however, in campaigns in hot countries, have more than its share of purely medical work. What has already been said in the last paragraph applies even more forcibly to this. There is usually no time, on account of the necessity for rapid evacuation, for making an elaborate diagnosis or for instituting any routine of treatment. Should the means of making a microscopic diagnosis be made available, it is hardly

necessary to emphasize that the confidence of the medical officers in their work will be greatly strengthened and they will be able to apply promptly the necessary specific treatment which, as usually obtains in most acute epidemic diseases, is of most avail before the infection has reached its full development. The patient may be at the height of his illness by the time he reaches the field ambulance.

Officers in field ambulances should be provided with the means of giving intramuscular or intravenous injections of quinine or serum at a time when they are *most likely to save life*. No greater risk is entailed in doing so than in administering intravenous salines or hypertonic solutions to suspected cases of cholera by the apparatus which is provided in the outfit designed by Rogers and supplied to every field ambulance in the Force. The means of making an accurate diagnosis (*diagnosis station* to be discussed later) should be equally accessible to the field ambulance as to the regimental medical officer, and in point of fact the same organization can serve (and did serve during the war) both to their satisfaction.

The Casualty Clearing Station.

The work of the casualty clearing station in collecting sick from the field ambulances is greatly simplified if the majority of medical cases enter the station with a diagnosis already correctly made. The process of evacuation, which is all important as a preliminary to active hostilities, is rendered more certain and more rapid. Those medical cases which are critically ill can usually be retained till the full diagnosis has been worked out.

The casualty clearing station, or a group of such stations, as often obtained during the war, should be provided with a laboratory organization of their own as was done in France from 1915 on. Such a laboratory, as will be explained later, should be in a position to do extremely rapid microscopic diagnosis on a large scale when required, and at the same time be so equipped as to undertake more elaborate laboratory diagnosis when necessary. Such a laboratory (field laboratory) should be in a position to undertake the examination for possible carriers of disease on a large scale, should be able to test water and food, and in every way its organization requires more elaboration than the simpler diagnosis unit situated nearer the firing line.

The medical officer in the casualty clearing station has a right to expect that, whenever time permits, a full investigation of his cases should be made. This is especially necessary in sub-tropical countries, when cases of dysentery may be complicated by superimposed infections of malaria, enteric, etc.

The Stationary and General Hospitals.

These hospitals serve in war-time the same purpose as general hospitals in times of peace. They are therefore provided with as elaborate laboratory

facilities as it is possible to give them, but diagnosis will be rendered much more easy and the supervention of obscure symptoms more readily understood, if attempts at making an accurate diagnosis have already been made farther up the line and, especially, if a record of the nature of these investigations is legibly recorded on such documents as accompany the man to the base.

The importance of such records, be they *either of negative or positive* value (and both may be equally suggestive), cannot be overestimated. Unfortunately it is necessary to observe that the importance of this aspect of the subject was not always appreciated as it might have been.

From the combatant's point of view primary diagnosis is all important. The more accurate the diagnosis, the greater saving there is of man-power in the long run. In a Force in which a large number of men are infected with malaria, it becomes a matter of primary importance that all such individuals should be known, and this can only be done if the diagnosis is made before the routine treatment with quinine is undertaken. If clinical symptoms alone are relied upon, the correctness of the diagnosis may be called into question at some subsequent period, or the fact that the man has suffered from malarial symptoms be overlooked, and therefore energetic quinine treatment may not be continued. Such an individual is probably more prone to relapse than if vigorous attempts are made in the first instance to stamp out the primary infection ; and one need hardly emphasize that a unit composed of malaria-infected individuals who are liable to suffer from relapses at any moment is apt to be ineffective from a military point of view. On the other hand, if all malaria-infected individuals or all dysenterics, who are also liable to relapse, are accurately known they can be placed in a separate category and allocated to special forms of suitable military service, or they may be formed into special units as was done in the later stages of the war.

In order to carry out this plan effectively, some uniform system of recording the bacteriological diagnosis upon the man's field card must be adopted. There are obvious objections from an administrative point of view in allowing this essential document to be sent to a military laboratory for the desired information to be inscribed upon it. The card may get lost and much confusion may result, or the necessity may arise for evacuating the man in the interval that must necessarily elapse in order for the examination to be made. On the other hand the provision of special cards upon which the bacteriological diagnosis may be inscribed is of doubtful value. My impression is that such an *extra* card is very liable to be lost and with it much essential information. It was my experience that these cards were often lost or intentionally destroyed on the journey down the line, or they were so crumpled or soiled as to become illegible on the man's admission to a stationary or base hospital. This is admittedly a difficult problem to solve and it is suggested that the difficulty might be overcome by the provision of special stamps bearing the diagnosis "malaria benign

tertian," "malaria malignant tertian," "dysentery bacillary," "dysentery amœbic," etc. The impression of the stamp should be made on the head of the field card in a prominent position. It is most essential that indelible ink should be used; writing in pencil should be avoided, for the diagnosis in this case is soon rendered illegible. The function then of the officer in charge of the laboratory should be to communicate his diagnosis, as rapidly as possible, direct to the officer in charge of the case, and a separate document must be provided for this purpose, but the latter should be responsible for stamping the diagnosis on the field card and for stating the amount of serum, quinine, or whatever the drug may be, which has been administered to the patient as a sequel to this diagnosis.

Such a system would necessitate the provision of several of these sets of stamps for each field ambulance and casualty clearing station. Of course the names of other diseases may be included; it being understood that when such a *diagnosis is used the corresponding parasite of the disease has been found in the laboratory or that the diagnosis is based upon appropriate laboratory tests.*

I admit that there may be considerable difficulty in the administrative aspect of what may seem to be a minor point, but it was my experience that with goodwill these difficulties could be overcome. It is the *adoption of a uniform system of recording diagnosis and treatment* that is so desirable.

The Bearing of Medical Diagnosis on the Military Situation.

A study of the excellent volumes on the Medical History of the War now being issued impresses the student with the extent to which epidemic disease overshadowed the military situation in the Eastern theatres of war, particularly in Macedonia, Palestine, East Africa and Mesopotamia, where a ceaseless struggle was being waged against disease which was certainly as formidable in causing casualties as any enemy force encountered in these countries. Each theatre at one time or other was brought into prominence on account of the prevalence of some tropical disease; we may mention outbreaks of malaria, bacillary dysentery, paratyphoid fever, diphtheria, schistosomiasis and heat-stroke.

From the spring of 1917 to the end of the war the tropical disease which remained pre-eminent through all the Eastern battlefields was undoubtedly malaria.

The field of operation with which I had the longest acquaintance was Palestine, and there the morbidity, and mortality, especially from subtertian malaria, reached its maximum in the autumn months of 1918, and it was there that the necessity for some such organization as outlined above was felt. This led to the establishment of diagnosis stations, the utility of which was put to the test during the final advances into Syria, and their practicability and usefulness completely established.

During the march across the waterless desert from the Suez Canal to

the borders of Palestine, indigenous malaria was almost unknown amongst the troops, but immediately after the capture of the Gaza-Beersheba line at the beginning of November, 1917, it became apparent that a highly malarious country had been entered. The history of Palestine bristles with accounts of campaigns and the astonishing feature that emerges from a study of these records, with the sole exception of that of the Egyptian Expeditionary Force, is the number of monumental failures.

Encamped near Jericho, we learn from the book of Kings[1], the hosts of Sennacherib, king of Assyria, appeared threatening Jerusalem. The plague that smote the Assyrians in their camp that night to the number of "an hundred fourscore and five thousand" was probably the subtertian malaria, indigenous, even at that time, to the Valley of the Jordan.

In the twelfth century "fever and pestilence" dogged the footsteps of the crusading armies, and many of the valorous knights of Europe left their bones bleaching upon the Plain of Sharon. Again, at the commencement of the nineteenth century, Napoleon's expedition was constantly hampered by malaria till finally cholera broke out near Acre, and he was compelled to hasten back to Egypt.

A report by Mühlens on malaria in Palestine published in 1913 (*Centralbl. f. Bakt.*, Abt.1 orig. Bd. 60) characterizes the districts of Jaffa, Jerusalem and Jericho, as highly malarious, and the subtertian parasite of this region as being of a virulent type. According to his statistics, 2,114 inhabitants of the Jaffa district were examined, and twenty-one per cent were found to harbour malaria parasites, while 201 cases, or forty-five per cent of those infected, were diagnosed as the subtertian parasite.

In the Jerusalem area nearly 8,000 inhabitants were examined, and 26·1 per cent found infected; the predominating variety of parasite being again the subtertian.

The report further stated that *Anopheles bifurcatus* was the commonest vector of the disease, and a particularly dangerous one on account of its habit of breeding in the cisterns in which the domestic water supply of the inhabitants is stored.

It was stated also that in the early autumn months, especially in mid-October, the subtertian malaria was apt to assume epidemic form and to produce serious and often fatal pernicious symptoms.

In the middle of November, 1917, British troops occupied the Jaffa area, and by the beginning of December of that year cases of fever began to occur in the regiments holding that portion of the line. Several sudden deaths occurred in casualty clearing stations in men who had been admitted with a variety of provisional diagnoses such as debility, influenza, mental deficiency. At autopsy they were found to be suffering from an overwhelming infection with the subtertian parasite.

By the end of that month a large proportion of cases, which had on

[1] 2 Kings xix, 35.

clinical grounds been provisionally diagnosed as influenza, were found on blood examination to be malaria also.

With perhaps the exception of syphilis, there is probably no other acute specific infection which may simulate the symptoms of other diseases more than does subtertian malaria. In order to make my meaning more explicit, I have drawn up a list which sets forth the provisional diagnosis with which the men were admitted to hospital, it being understood that this was made purely on clinical symptoms in the absence of any blood examination, such as I am advocating.

One or more of these examples actually occurred with fatal results.

Subtertian Malaria.

I.—*Cases with Cerebral Symptoms.*

Preliminary or Provisional Clinical Diagnosis.	Corresponding Clinical Type of Subtertian Malaria.
"Sun-stroke" or "heat-stroke."	Comatose or delirious type with hyperpyrexia.
Mental deficiency or mania.	Maniacal type of cerebral malaria with suicidal tendencies.
Epilepsy.	Cerebral malaria with epileptiform convulsions.
Cerebrospinal meningitis.	Cerebral malaria with spinal symptoms.

II.—*Cases with Abdominal Symptoms.*

Dysentery.	Abdominal malaria with passage of blood in stools.
Cholera or paracholera.	Choleraic or algid form with subnormal temperature and collapse.
Intestinal obstruction.	Clinical condition produced by blockage of intestinal capillaries by sporulating subtertian parasites.
"Appendicitis."	Abdominal malaria with pain and tenderness in the right iliac fossa.

III.—*Cases with Icteric Symptoms and Pain over the Hepatic Area.*

Jaundice, infective jaundice, cholecystitis, etc.	Bilious remittent form of subtertian malaria with vomit of bile.

IV.—*Cases with Pulmonary Symptoms.*

Bronchitis, pneumonia and pleurisy.	Malarial pyrexia with superadded pulmonary congestion, and cardiac distress due to malarial myocarditis. Pleuritic pain over the left hypochondrium being possibly caused by congestion and rapid enlargement of the spleen.

V.—*Cases with Nephritic Symptoms.*

"Acute nephritis" or "nephritis."	Subtertian malaria with general anarsarca and the excretion of albumin and sometimes blood into the urine.
Hæmaturia.	Methæmoglobinuria or black-water fever.

VI.—*Cases with Skin Lesions,*

Purpura "Measles."	Septicæmic type of subtertian malaria with multiple cutaneous hæmorrhages. These cases are rare, but two were encountered.

VII.—*Cases of Average Severity.*

(*a*) "Influenza" or "rheumatism."	Malarial pyrexia with arthritic pains.
(*b*) "Enteric," "sandfly fever," "trench fever," "relapsing fever."	Average cases with pyrexia. Enlargement of the spleen not necessarily detectable.

VIII.—*Sequelæ.*

Cachexia and anæmia diagnosed as "pernicious anæmia," "leucocythemia," "debility."	Splenomegaly and great anæmia due to blood destruction.

The contemplation of a list such as this indicates, to some extent, the fallacy of too implicit a reliance upon clinical symptoms alone in making a diagnosis in tropical disease, especially in malaria. The same principle applies to the diagnosis of dysentery, where it is very often as impossible to differentiate the commoner forms without a laboratory diagnosis, as it is to distinguish relapsing fever from malaria or other fevers producing splenomegaly and anæmia.

The following well-defined diseases were anticipated and actually did occur to a very considerable extent in the force under consideration. With the exceptions to be mentioned, a primary diagnosis can be made in all cases by simple microscopic examination by a competent microscopist.

(1) Malaria (benign tertian and subtertian).
(2) Relapsing fever.
(3) Bacillary dysentery.
(4) Amœbic dysentery.
(5) Schistosomiasis.
(6) Enteric fever.
(7) Typhus fever.
(8) Cholera.
(9) Diphtheria.

Malaria.

The diagnosis of malaria of both the main varieties is the most important, as it is most readily performed with the minimum of laboratory apparatus. All that is required is an adequate supply of microscope slides, a sufficiency of properly prepared Leishman's stain, and fresh neutral distilled water. In order to conserve the stain for work of this kind, and in order to facilitate the washing in the absence of sinks, it has been found more suitable to carry out the whole staining process by means of drop pipettes. The portion of the film to be stained can be marked out by means of a grease pencil, which will save stain and distilled water. A great many slides can be stained by this method at the same time.

Small details, such as the method of marking slides, so that they may be identified after staining, are of prime importance. Affixing a label with the man's name and number is for various reasons unsatisfactory. The best and most certain method I found was to scratch these details by means of a needle on the blood-film itself. Boxes of the regulation size used for safety pins form the most handy receptacles wherein to transport blood-films from a distance to the laboratory, so as to prevent them from becoming scratched or otherwise spoiled.

During my experience of this work thin films have been employed throughout. When the parasites are abundant in the peripheral blood they are much more easily distinguished in a thin film than in a thick one; moreover differentiation of the species (which from the military standpoint is important) is much more readily made. I am aware that the thick film method has been utilized on a large scale, with apparent success, in Central Africa and that the crescent stage of the subtertian parasite, especially when scanty, can be more readily distinguished by this method, but for work of this description I relied upon the thin film as being more trustworthy.

Fallacies are apt to arise from single blood examinations on a large scale; a considerable proportion of infections will thereby be missed,

especially when the subtertian parasite predominates. This difficulty has possibly a twofold explanation ; the infection may be a very scanty one and so easily missed, or the young schizonts may not appear in the peripheral blood for thirty-six hours after the commencement of the fever; this anomaly may be ascribed to the method of sporulation in the capillaries of the internal organs, which is peculiar to the subtertian parasites. In cases of doubt, therefore, three or more blood examinations may be necessary in order to establish a definite diagnosis. For this reason it has been found necessary to adopt the *three slide rule*, that is to say, in a suspicious case blood examination should be performed on three separate occasions after an appropriate interval of time between each. The primary examination should be made in the diagnosis station, the two latter ones by the time the patient has been evacuated to the casualty clearing station. The recognition of this factor—a most important one—involves the adoption of some concerted action. It becomes necessary for some conventional sign, such as a cross or a star, to be stamped upon the field card to designate that the blood has been examined once or twice with a negative result. It may be added that in rapid work of this description clinical signs and symptoms count for little. In the large majority of cases of early malarial infection, there may be no detectable enlargement of the spleen to act as a guide. The differential diagnosis between the two main kinds of malaria is important, for under certain circumstances it may not be necessary to evacuate cases of benign tertian malaria to the base at all.

Relapsing Fever.

This infection is apt to arise in any campaign, and, in its initial stages, is clinically indistinguishable from malaria.

From the point of view of prevention and treatment, it is most important that it should be recognized in the early stages. The spirochaetes, or spironemata, are most numerous in the peripheral blood and are therefore most easily detectable in the earlier stages of the fever. The same principles detailed in the case of malaria apply equally to this infection. The films taken in routine fashion are made and stained the same way by Leishman's stain which shows up the parasite to advantage. When the parasites are scanty in the peripheral blood (as they are in certain clinical types of the disease, namely, the variety found in the Near East and caused by *S. berberum*), it may be necessary to examine thick preparations of blood, dehæmoglobinized, and stained by carbolfuchsin for this purpose.

In blood infections *diagnosis stations* fulfil their most important function in detecting malaria and relapsing fever, diseases which require totally different methods of treatment (i.e., quinine and salvarsan) with highly specific drugs, and which are most efficacious if exhibited in the early stages of the disease.

DYSENTERY.

The primary diagnosis of dysentery is an all important subject, and is secondary in importance to examination of blood. The intense study of the *cytology* of the stools during the War has led to a better understanding of this subject. For all practical purposes, the primary diagnosis of dysentery can be made, in the absence of a necessarily prolonged bacteriological investigation, by the simple study of the cells in the stool. From the point of view of treatment, evacuation, invalidism, and in fact from any point of view, it is of the utmost importance that the primary diagnosis should be established in the early stages of the disease.

BACILLARY DYSENTERY.

The exudate from the rectum and large gut in this very acute and often fatal infection is often wrongly termed a stool. The blood and mucus comprising the exudate contains a very large number of polymorphonuclear cells, such as one would expect in a particularly virulent bacillary infection. The preponderance of these cells in a simple microscopic preparation, together with the characteristic refractile "endothelial macrophages" and the absence of active *Entamœba histolytica*, render the diagnosis of "probable bacillary dysentery" justifiable, and give the clinician sufficient grounds for the immediate treatment which is so important. The exact nature of the infecting organism, whether the Shiga or Flexner bacillus, is of less moment. It is generally acknowledged that the most virulent and rapidly fatal cases are usually due to the former bacillus; hence it is important that the antiserum employed for injection should be especially potent in Shiga antigens. The exact proportion of the two organisms in any given epidemic is an academic matter, and one which should be left to the field laboratories or more elaborate organizations to work out. It is by no means necessary, either from a medical or military point of view, that the infecting organism should be accurately ascertained in every case of bacillary dysentry.

The method of cytological diagnosis is one which I had long utilized in the preliminary diagnosis of bacillary dysentery, but is one which has been elaborated and fully described by Willmore and Shearman (*Lancet*, 1918, ii, pp. 200-206); it is a very simple procedure and one which can be employed by a microscopist after short preliminary training.

I would like once more to emphasize the fact that the diagnosis of bacillary dysentery is most easily made in the earlier stages of the disease. Hence it follows that as the infection is most generally widespread in the front line, most cases will be actually positively diagnosed by the forward laboratory units. More cases of amœbic dysentery, proportionately, will be diagnosable in the *base* laboratories. Sufferers from the bacillary disease are already convalescent by the time they have reached the base and can no longer be bacteriologically diagnosed. The non-appreciation of these factors has led to much misconception.

Amœbic Dysentery.

The diagnosis of amœbic dysentery and its differentiation from the bacillary disease so distinct in its ætiology, but which may simulate it very closely in clinical symptoms, depends upon the discovery and recognition of the *E. histolytica* in the exudate or stools. This is by no means always an easy matter. It may happen that, although subsequently present in large numbers, the entamœbæ may be very scanty in the particular specimen under examination, or even, for some unexplained reason, they may be altogether absent, as far as can be ascertained, from a particular specimen of excreta. These organisms, moreover, die out very rapidly within a few hours of the time the stool has been passed. It is therefore necessary to examine a fairly fresh specimen in order to obtain a positive result. Even in the absence of the entamœbæ, as Willmore has pointed out, a very strong indication of the causal organism may be obtained by the character of the cellular exudate. The almost complete absence of polymorphonuclear cells and the fragmentary remains of endothelial and other cells which may appear in the exudate point to an amœbic infection. From the view of ultimate recovery, rapid diagnosis of amœbic dysentery is by no means so important as it is in the bacillary form. Amœbiasis is by no means such a rapidly fatal or disabling disease, and by reason of its liability to relapse, the nature of the infection will most certainly be recognized during subsequent investigations.

But too much stress cannot be laid upon the point that, from the view of treatment and subsequent disposal of the patient, the *primary diagnosis in dysentery is an all-important one.*

Schistosomiasis.

The diagnosis of urinary or rectal schistosomiasis is readily made by the recognition of the characteristic ova, either in the urine or the fæces. The ova can be found, it may be comparatively easily, under a low power, by simple microscopic examination. In the absence of a centrifuge, the ova sink to the bottom of the glass or other receptacle on sedimentation, and may then be recognized. The necessity or urgency of such an examination is never likely to arise on any comprehensive scale.

Enteric Fever.

The bacteriological diagnosis of the enteric fevers, either by blood cultures or serological reactions, cannot be undertaken by any forward diagnosis unit, but must always be left to the more elaborately equipped laboratories in the rear. Blood culture entails scrupulous technique, the provision of incubators and culture media. The serological reactions do not usually become definite in the early stages of the illness when these cases are likely to be first encountered and they entail the provision of properly prepared bacillary emulsions. It is true that serological diagnosis,

from a purely diagnostic point of view, has been greatly simplified by the employment of the *agglutination forcée* method, using Garrow's agglutinometer, a method which is eminently suitable for the field laboratory (see Manson's "Tropical Diseases," seventh edition, 1921, p. 899).

Typhus Fever.

The principles which apply to the diagnosis of enteric also apply to typhus fever in a greater degree. The only laboratory test of any scientific value is the Weil-Felix reaction. This is an agglutination test and is best performed on Garrow's agglutinometer and in a field laboratory.

Cholera.

The bacteriological recognition of cholera in war-time is a most important subject, not only from the point of view of diagnosis, but also from that of hygiene and all the necessary restrictions in military movements which it entails. Therefore the organization for the rapid diagnosis must be elaborated with care and such a skeleton scheme should always be in existence. For this purpose the diagnosis unit provides an admirable foundation. To isolate, recognize and fully work out the cholera vibrio on modern lines necessitates biochemical, serological and hæmolytic tests and is a long and tedious business. Even in a fully-equipped laboratory with numerous skilled assistants, it takes a week or more to perform.

This obviously cannot be done in a diagnosis unit when evacuation of the patient is an all-important matter. A reliable and much shorter method of recognizing the vibrio is obviously very desirable, and, with a little elaboration, a *diagnosis unit can be expanded so as to undertake this work.* The method which I employed in Palestine and which has been described by A. Davies (Journal of the Royal Army Medical Corps, 1920, vol. xxxv, No. 4, p. 329) consists of agglutinating the bacillus, in primary culture in alkaline peptone water, with specific anticholera serum upon a Garrow's agglutinometer. This entails the provision of a large incubator and large numbers of sterilized tubes of peptone water. It has been ascertained that reliable recognition of the cholera vibrio can be made by these means in as short a period as from twenty-four to thirty-six hours. The advantages which this method offers from a military point of view should be obvious to all, but its possibilities do not as yet seem to have been adequately recognized.

(*To be continued.*)

ELABORATION OF A METHOD SUITABLE FOR CONDUCTING COMPLEMENT FIXATION TESTS IN GONORRHŒA.

A REPORT TO THE MEDICAL RESEARCH COUNCIL.

By W. J. TULLOCH, M.D.

(From the Department of Bacteriology, University College, Dundee, The University of St. Andrews.)

In a previous report to the Medical Research Council dealing with the serological classification of gonococci, it was shown that the majority of cases of gonorrhœa (seventy per cent) were caused—in this country at least—by one group of gonococci. This observation makes possible further investigation of the complement fixation reaction, for, a priori, one would expect that one (type I) antigenic strain of the gonococcus would subserve as the antigen for complement fixation tests in at least seventy per cent of the cases of the disease.

The value of one antigen derived from one strain is that its qualities are more easily investigated and more readily controlled than are those of antigens prepared from numerous strains of the micro-organism. This tends to make the technique more reliable, or at least more easily controlled, and the advantage of a reliable complement fixation test, for the diagnosis of the less obvious manifestations of gonococcal infection and for the control of treatment is self-evident.

So far the tests employed have been not merely unreliable, but actually misleading, lacking apparently both specificity and delicacy, unless in the hands of highly specialized workers. Some, it is true, have claimed that the test when performed with certain specified techniques is almost as valuable in the study of gonorrhœa and its complications as is the Wassermann reaction in the investigation of syphilis. Most of the papers which call attention to its value are of American origin, and Kolmer, Schwartz and McNeill and Torrey all regard it as a method worthy of extended application. Torrey, Wilson and Buckell (*Journ. Infect. Dis.*, vol. xxxi, No. 2, August, 1922, pp. 148-158) state that: "In the chronic stages of gonorrhœal infection, and also in the clinically doubtful cases, complement fixation tests, carefully controlled, will give a much higher percentage of positive diagnosis than cultures or smears, and that this test constitutes at present the simplest and most effective single guide for the control of such cases."

They conclude: "That the smear, cultural and complement fixation methods of diagnosis in chronic gonorrhœa of women have all proved useful, and that their relative values correspond to the order in which they are named, the last being the most valuable."

Notwithstanding these findings in America the test has never been

popular in this country, and, indeed, one institution in which diagnostic procedures constitute an important department of its activities has so far refused to carry out complement fixation tests in gonorrhœa because of the entire lack of reliability of such tests.

Considering these diametrically opposed opinions it seemed worth while making an exhaustive examination of the various factors which might be responsible for the disparity of results obtained by these different investigators.

I.—Factors which render especially difficult the Technique of Complement Fixation in Gonorrhœa.

(1) *Poverty of Humoral Reaction in Gonorrhœa.*—Gonorrhœa, remaining in the majority of cases an infection strictly limited to a circumscribed area of one mucous membrane, and that of small superficies, does not call forth a marked humoral response. Therefore, the first requisite of any fixation of complement test to be used in diagnosis of this malady is delicacy of reaction, provided, of course, that this is obtained without loss of specificity.

Nevertheless, even if an extreme degree of delicacy is attained which allows of those antibodies that are present in the serum being demonstrated by the test, it must be realized that, from the very nature of the disease, especially in the male, in a certain percentage of cases the antibody response will be so slight as to be undemonstrable by any method.

One factor influencing the delicacy of the test then is the quantity of patient's serum used, and at first sight it would appear that as large a quantity of this as is compatible with specificity of reaction should be employed in the test. But it has been shown by Teague and Torrey (*Journ. Med. Res.*, vol. xvii, 1907-8, p. 223) that when, at least, the serum of experimentally immunized animals is used in conducting gonococcus complement fixation tests one frequently encounters the "zone phenomenon," in which a negative result is obtained with higher concentrations and a positive result with lower concentrations of the same serum in presence of the same (homologous) antigen. This factor, while, perhaps, of minor importance in the diagnostic application of the test, is certainly not negligible, for out of 100 tests performed to date with human serum derived from cases of gonorrhœa, five have exhibited well marked zone phenomena. This is almost to be expected, for with the realization that complement fixation and also agglutination are essentially delicately balanced interactions of colloids, one feels that it is remarkable, not that zone reactions are encountered, but that they are met with so infrequently.

Especially is this so when one of the reacting bodies—serum—itself an extremely complex mixture of colloids, certain of which may, and in some circumstances are known to influence the behaviour of others present along with them, is contained in the mixture in relatively high concentration.

Bearing this in mind, two practical suggestions at once emerge: (*a*) that the serum under examination must be tested in sufficient concentration to allow of the demonstration of a weak response; (*b*) that the serum under examination must be tested over a sufficient range of dilutions to preclude the danger of misleading results being obtained because of zone reactions.

In the case of (*b*) no difficulty arises, but in the case of (*a*) a theoretical difficulty has to be borne in mind, viz., that many normal human sera contain natural (? heterogenetic) antibodies to the red cells of other animal species, and if we are to use fairly large quantities of human serum in the tests these natural antibodies should be removed by absorption with the requisite red cells before the test, so that they do not influence the cells of the hæmolytic system.

An attempt was made to determine the frequency with which natural antibodies to sheep cells occurred in human sera and it was found that of 100 specimens of inactivated human serum no less than 35 sensitized sheep cells to the dissolving action of 2 m.h.d. of guinea-pig complement, when the tests were made under the following conditions:—

Inactivated human serum 0·1 cubic centimetre, and washed unsensitized sheep cells 3 per cent suspension 0·1 cubic centimetre were mixed and allowed to stand at 37° C. for one hour. There was then added 2 m.h.d. of guinea-pig complement contained in 0·2 cubic centimetre and the tube incubated in a water bath for one hour at 37° C.

The complement was, of course, absorbed with washed sheep cells before being used, as guinea-pig serum also not infrequently contains antibodies to the red cells of different animal species, including those of the sheep. To show that absorption of these had been complete a control tube containing cells, saline, and four m.h.d. of complement was included in the series and exhibited no lysis.

Whether these natural antibodies of human serum really constitute a factor of practical importance is perhaps doubtful, but their presence interferes to some extent with the accurate standardization of other reagents employed in the test, and as their elimination by absorption presents no difficulty and but little extra labour it is well to be rid of them.

To eliminate from sera these natural antibodies to sheep cells (I have used sheep cells in my hæmolytic couple, but the principle is of general application) the following procedure has been used:—

The tubes containing the blood to be tested are centrifuged as soon as possible after delivery at the laboratory, the serum is pipetted off and inactivated at 56° C. for fifteen minutes. Thereafter it is stored at or below 0° C. till the evening before the test is to be carried out. On the evening before the test there is added to each cubic centimetre of serum 0·1 cubic centimetre of a thick cream of washed cells obtained by centrifugalization at 3,000 r.p.m. for fifteen minutes. The tubes of serum with the added cells are stored in the ice chest overnight. On the morning of

the test they are centrifuged, the clear serum is removed, and again inactivated for fifteen minutes at 56° C.

(2) *Complement and Hæmolytic Couple most suitable for the Test.*—Excepting antigen, complement is the most critical reagent of the test and before use it should be investigated, as is done in the Wassermann reaction, to determine its activity and its deviability in presence of antigen without serum—i.e., to show that it does not exhibit non-specific deviation. The real difficulty is that we are forced to titrate the quality of complement in terms of its hæmolytic activity, whereas its function in the test is to be deviated or not deviated according to whether an homologous "antibody-antigen complex" is, or is not, present. The deviability of complement on exposure to homologous complexes bears no relationship to its hæmolytic quality as has been clearly shown by Noguchi and Bronfenbrenner (*Journ. Exp. Med.*, No. 13, 1911, pp. 69 and 78), and by others in the case of the Wassermann reaction and the same holds true for the test under discussion. The figures of Noguchi and Bronfenbrenner show that of forty-one guinea-pigs the complement derived from one was undeviable by a Wassermann complex, eight exhibited but slight deviability—less than 3 m.h.d.—and the remainder showed deviation of from 4 to 10 m.h.d. in presence of the same complex.

If guinea-pig serum be used then as complement in the test under consideration we are faced with this same difficulty, namely, that in a certain number of instances the complement will be deviated readily while in other instances it will be practically undeviable. Bearing in mind what is noted in the previous section of this report it will be appreciated that this is a very real difficulty.

A small number of experiments was undertaken to determine the relative numbers of guinea-pigs which are in this sense suitable or unsuitable for the fixation reaction in gonorrhœa, but the series examined was too small to permit of the results obtained being expressed as percentages. It was found, however, that of thirty animals investigated nine were unsuitable in that two m.h.d. of the complement derived from them were not deviated in presence of a known couple consisting of a suspension of gonococci in presence of experimental (rabbit) antigonococcus serum. This finding is in substantial agreement with the results obtained by M. A. Wilson (*Journ. Immunology*, 1918, vol. iii, No. 5), who found that of 129 guinea-pigs only eighty-eight were efficient as the source of complement to be used for fixation tests in gonorrhœa. Moreover, one must not lose sight of the fact that guinea-pig serum frequently contains natural antibodies to sheep cells, and when guinea-pig complement is used along with a sheep cell hæmolytic system, it is advisable, if not essential, to eliminate these by absorption with sheep cells prior to its being used in the test. This is done in the same way as the natural antibodies of human serum are eliminated—to each cubic centimetre of complement one adds 0·1 cubic centimetre of washed sheep cell cream and maintains the mixture at 0° C. overnight.

The difficulty arising from this variation of deviability of complement is almost insurmountable, but two possibilities suggest themselves:—

(*a*) That the complement to be used in such tests be obtained always from the same animal.

(*b*) That a constant and small multiple of hæmolytic units as determined by preliminary titration be used in the tests, the variant introduced to assess the degree of reaction being serial dilution of the serum under examination.

If suggestion (*a*) be considered, it is seen that a large animal must be used and that animal must be always available. This in many instances would mean that the source of complement would be a member of the laboratory staff. If human complement exhibited sufficient activity and at the same time was readily deviated it would be a valuable reagent from this point of view. A number of tests were therefore carried out to determine the relative complementary activity of my own serum and that of guinea-pigs, the tests being made in the first place using human cells sensitized with anti-human corpuscle serum (rabbit). The object of the experiment was to determine if it were possible to eliminate from the test all reagents of origin other than human, excepting always antigen and anti-corpuscle serum, for if such could be done the difficulties arising from the presence of natural antibodies in, and heterogenetic relationships between, the various constituents of the test would disappear. The results of these tests in which reagents only of human origin were employed showed that such a hæmolytic system demanded the presence of too much complement and too much anti-corpuscle serum to be serviceable.

The next test that was made was to determine the activity of guinea-pig complement and human complement in respect of sensitized sheep cells.

A moderately active anti-sheep corpuscle serum was chosen (titre 0·0005), was diluted 1 in 100 with saline and was then distributed into a series of tubes in falling concentration as shown in the following table, the volume being made up to 0·5 cubic centimetre with saline.

Fresh human serum (my own) was absorbed with sheep cells and was used as complement in the test in a volume of 0·05 cubic centimetre in each tube.

Fresh guinea-pig serum absorbed with sheep cells was used with the second series of tubes in volume of 0·05 cubic centimetre.

A five per cent suspension of sheep's red cells washed in the usual way was added to the series in a volume of 0·5 cubic centimetre per tube.

Incubation was for one hour at 37° C. in a water bath.

The following results were obtained:—

ANTI-SHEEP CELL SERUM 1/100.

	0·1	0·09	0·08	0·07	0·06	0·05	0·04	0·03	0·02	0·01	0·0
0·05 c.c. human serum	—	—	—	—	—	—	—	—	—	—	—
0·05 c.c. guinea-pig serum	+	+	+	+	+	+	+	+	P	—	—

C is the control. P means partial lysis.
+ means complete lysis. — means no lysis.

This clearly shows that my own serum is of poor lytic quality, and that even with an "anti-sheep corpuscle serum sheep corpuscle complex" its use was precluded, for it seemed probable that owing to the quantity of serum required, the deviation of its active qualities would probably not occur with sufficient delicacy.

Although this seemed probable it was necessary definitely to investigate the question, and a number of fixation tests were set up using two m.h.d. of human complement in presence of known homologous couples of gonococcus suspension and antigonococcus serum. No demonstrable deviation took place, and I was reluctantly forced to the conclusion that my own serum could not be used as the source of complement because of the concentration required to produce hæmolysis and because of its lack of deviability in that concentration.

A further series of tests was then set up to determine the activity of guinea-pig complement in various hæmolytic systems. In these tests the cells (five per cent suspension) were sensitized with three m.h.d. of their respective antisera and the complement was absorbed with the corresponding red cells before use. The volume of sensitized red cells employed was one cubic centimetre, the tests being carried out in tubes of small calibre. All the constituents of the tests were present in constant quantity excepting the complement, which was diluted one-fifth and distributed as in the following table. The volume of fluid in each tube was made up to 0·4 cubic centimetre, and incubation was for thirty minutes at 37° C. in a water bath.

COMPLEMENT 1/5 ABSORBED WITH RESPECTIVE CELLS.

	0·1	0·09	0·08	0·07	0·06	0·05	0·04	0·03	0·02	0·01	Cont.
Sensitized human cells ..	+	+	P	P	t	—	—	—	—	—	—
Sensitized ox cells ..	+	+	+	+	+	P	P	t	—	—	—
Sensitized sheep cells ..	+	+	+	+	+	+	+	+	ACL	t	—

+ means complete lysis. P means partial lysis.
t means trace lysis. ACL means almost complete lysis.

Note.—The results in the test with human cells were very difficult to read as the anti-human corpuscle serum caused marked agglutination of the cells, to some extent interfering with their solution.

These results showed that the most delicate hæmolytic system and therefore presumably the best, of those examined was the sheep cell system, but in using it one must absorb the complement with sheep cells prior to making the tests.

Let us now consider the alternative suggestion (*b*), which from these experiments is imposed upon us, "That a constant and small multiple of hæmolytic units of complement as determined by preliminary titration be used in the test, the variant introduced to assess the degree of reaction being serial dilution of the serum under examination."

It is obvious that were such a method adopted it would be well to employ the most active complement obtainable so that the desired active quality of complement be present with a minimum of its vehicle. This really means

that guinea-pig complement should be chosen. But the adoption of such a method involves another important consideration, namely: *that the antigen used must possess good deviating qualities in presence of antibody but must not itself exhibit anticomplementary qualities.* This is essential, for if the multiple of m.h.d. used in the tests be, for example, 1·5 or 2, then summation effects of slight anticomplementary activity of serum to be tested, plus slight anticomplementary action of antigen, will assuredly give false positive results, which do not appear in control tubes of serum alone, or antigen alone. This consideration naturally led to a series of investigations concerning the preparation of antigen.

(3) *Preparation of Antigens.*—The antigen is quite as critical a constituent of the test as is complement. That this is so is evidenced by the large number of methods which have been described for preparing this reagent, indeed they are so many that all cannot be reviewed, and although none of them can be called wholly satisfactory one hesitates to describe yet another.

Most authors seem to be agreed that several strains of gonococci should be employed in making the antigen, but in view of the fact that about seventy per cent of the cases of gonorrhœa are caused by infection with the same, or very closely related, strains of the micro-organism as determined by absorption of agglutinins, and still more when it is remembered that complement fixation is not so specific a test as is absorption of agglutinins, at least in its application to most bacterial species—it seems to me unnecessary and possibly may be inadvisable, especially for purposes of research, to use such mixed antigens. That there is good reason for this is shown by the work of Thomsen and Vollmond (*Acta Medica Scandinavica*, 1922, vol. lvii, No. 1) who found that while simple complement fixation failed to subdivide the gonococci into serological subgroups, absorption of antibodies followed by complement fixation, using the absorbed serum for making the tests, did satisfactorily differentiate the gonococci into one main group and three other groups of subsidiary import.

I have, therefore, limited myself to preparations made from organisms proved by absorption of agglutinins to belong to the predominant type and a series of investigations was carried out with antigens prepared therefrom by a variety of methods.

Since Bordet and Gengou (*Ann. de l'Inst. Past.*, 1901, p. 289) first described the technique of complement fixation, using simple saline suspensions of micro-organisms as their antigens, many efforts have been made to improve upon that method, and a variety of procedures have been elaborated with a view to improving the specific fixing qualities of the antigen. The real difficulty arose when Moreschi (*Berlin Klin. Woch.*, 1906, xxxviii, p. 1243) pointed out that frequently simple saline suspensions could not be used because the bacterial cells themselves exhibited anticomplementary qualities which may completely mask true fixation of complement. To overcome this difficulty many different methods have been employed, and

most of these involve the attempted breaking down of the micro-organismal protoplasm so that an extract which might subserve as an antigen devoid of anticomplementary qualities was obtained.

REVIEW OF SOME OF THE METHODS SUGGESTED FOR PREPARING GONOCOCCUS ANTIGENS.

(*A*) *Solution by Alkalies.*—One method based on solution of the gonococcus by means of alkali as described by Thomson (*Medical Research Council, Special Report Series*, No. 19, 1918, p. 31), has received considerable attention and it appears to have met with some success, but it is a method open to criticism on two grounds, one purely practical and the other theoretical.

The practical difficulty is that after the addition of the alkali used to dissolve the micro-organism one must use acid to obtain a neutral end-product and this addition of acid must be carried out with extreme care lest the end-product be slightly acid or slightly alkaline. A very slight degree of acidity or alkalinity markedly affects the delicacy of all reactions in which hæmolytic complexes constitute the indicators of fixation. If such deviation from neutrality only affected the reaction in one direction, the difficulty could be readily overcome by the use of suitable controls, but unfortunately lysis may be stimulated or inhibited by either acid or alkali depending upon the concentration of H or OH ion present in the final mixture. Thus Brown and Kolmer (*Amer. Journ. of Syph.*, 1919, iii, p. 8), while investigating the influence of reaction upon the Wassermann test found that "minute quantities of alkali or mineral acid are markedly antilytic probably by means of a deleterious influence on complement, and if present in test tubes or other glassware may yield falsely positive Wassermann reactions, conversely larger amounts may prove hæmolytic and thereby yield non-specific negative reactions." They state that 1 cubic centimetre of approximately N/400 NaOH in 3 cubic centimetres of fluid may prove anticomplementary, while 1 cubic centimetre of N/100 in the same volume may produce hæmolysis. Figures of the same order were obtained by these authors in investigating the influence of acids upon the process of hæmolysis. These observations of Brown and Kolmer have been corroborated by Manwaring (*Journ. Infec. Dis.*, 1904, i, p. 112), Hektoen and Reudiger (*Journ. Infec. Dis.*, 1904, i, p. 379), Cumming (*Journ. Infec. Dis.*, 1916, xviii., p. 151), and also (unpublished observations) by Professor E. W. Reid, F.R.S., and his staff, in the laboratory of physiology, University College, Dundee. The difficulty arising from this source can only be overcome by diluting the antigen, and what is gained by the greater activity of antigens so prepared is liable to be lost because of the necessity to dilute the material in order to preclude danger from this source. Thus Thomson employs his antigen so diluted that it represents only 100 millions of cocci per cubic centimetre, but there is no difficulty in preparing by other methods

an antigen of gonococcus, which, although containing 1,000 millions of cocci, or the equivalent thereof, per cubic centimetre exhibits in that concentration no anticomplementary qualities.

The obvious theoretical objection to antigens prepared in this way is that they consist of material so altered by crude chemical action that they may no longer behave as true gonococcus antigens. Nevertheless they may give rise to fixations that are specific from a diagnostic viewpoint although due to a purely empirical reaction in the same sense as the fixation in the Wassermann reaction is empirical.

(B) Extraction with Fat Solvents and Digestion with Ferments.

Extraction of micro-organisms with fat solvents has been suggested and actually used in the preparation of bacterial antigens for the complement-fixation reaction. Douglas and Fleming (*Brit. Journ. Exper. Path.*, ii, 1921, p. 131) working with *B. typhosus* found that more specific reactions were obtained in tests with acetone extracted bacilli than in those in which simple saline suspensions of the same bacillus were used. The really valuable feature of Douglas and Fleming's finding was that extraction with acetone, while it did not interfere with the fixation qualities of the bacilli, did markedly reduce their non-specific anticomplementary action. In a later publication, Douglas (*Brit. Journ. Exper. Path.*, ii, 1921, p. 175) calls attention to the possible employment of extracted and trypsin digested bacteria as antigens in complement-fixation tests, but unfortunately he gives no account of experiments in which use was actually made of such extracted and digested micro-organisms for this purpose.

There is not the same objection to the use of bacteria extracted with fat solvents as there is to the use of those exposed to alkali, for the process does not involve actual destruction of the micro-organismal protein unless extraction be followed by digestion. Moreover, the difficulty arising from the presence of alkali or acid in the end product does not arise.

That the extracted bacteria are not markedly affected in their antigenic qualities is shown by the fact that inoculation of animals with acetone extracted (Douglas) or with ether or acetone and ether extracted (unpublished results from this laboratory) organisms calls forth a response different only in degree from that produced by the inoculation of "whole" suspension.

The following experiments show that acetone extraction reduces the anticomplementary qualities of gonococcus suspensions. The activity of a complement was first determined by putting various quantities of the guinea-pig serum into a series of tubes and making up to one cubic centimetre with saline. To each tube of the series was then added 0·5 cubic centimetre of a 5 per cent suspension of sheep cells sensitized with 5 m.h.d. of anti-sheep corpuscle serum. Incubation was for fifteen minutes in a water bath at 37° C. The result of this titration is shown in the following table:—

Complement							
0·05	0·04	0·03	0·02	0·015	0·01	0·005	Control
+	+	+	+	ACL	—	—	—

+ means complete lysis. ACL means almost complete lysis. — means no lysis.

0·02 cubic centimetre was therefore taken as the m.h.d. and tests to determine the anticomplementary action of four different antigens were then set up.

Two m.h.d. (0·04 cubic centimetre) of complement was put into each of four series of tubes, antigen in falling concentrations was added to make volume equal to one cubic centimetre as in the following table. The mixtures were incubated for two hours at 37° C. and 0·5 cubic centimetre of five per cent sensitized sheep cells added. Final readings were taken after thirty minutes' further incubation in the water bath at 37° C.

	Antigen (millions per c.c.) 1000	500	250	125	62·5	31·25
Strain "A" raw	—	—	—	+	+	+
,, acetone extracted ..	P	+	+	+	+	+
Strain "B" raw	—	ACL	+	+	+	+
,, acetone extracted ..	+	+	+	+	+	+

There is, then, a reduction of anticomplimentary quality after acetone extraction, but the value of this for the purpose in view depends not upon this reduction solely but also upon there being no, or relatively less, concomitant reduction of antigenic power with this lessening of anticomplementary activity.

To investigate this, the following test was set up :—

Into each of a series of six tubes was put 0·006 cubic centimetre of antigonococcus serum (rabbit) of agglutinating titre of 1/1600 along with varying quantities of antigens, as shown in the following table, and 2 m.h.d. of complement. The volume in each tube was made up to one cubic centimetre, and the tubes incubated for two hours at 37° C., whereupon 0·5 cubic centimetre of 5 per cent suspension of cells sensitized with 5 m.h.d. of antisheep cell serum was added and incubation continued in the water bath at 37° C. for thirty minutes. The quantities of each antigen tested were comparable, being $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ of the anticomplementary dose of each.

Acetone extracted cocci. millions per c.c.			Raw cocci. millions per c.c.		
500	250	125	125	62·5	31·25
—	P	ACL	—	P	ACL

Control tubes containing double the quantity of antigonococcus serum and others containing the highest concentration of each antigen were included, and all showed complete lysis.

It would appear from this experiment that although the acetone extraction has reduced the anticomplementary quality of the gonococcus it has correspondingly reduced its antigenic property. There is an obvious criticism to this experiment, viz', that the quantity of antigonococcus serum employed was unduly small, but the experiment was designed solely to show whether acetone extraction presented a *great* advantage in the preparation of antigen.

(*C*) *Antigens* (i) *as advised by the Bureau of Laboratories, City of New York, also* (ii) *Antigen prepared by Tryptic Digestion of Ether-extracted Gonococci.*—(i) A method of preparing bacterial antigens suitable for the gonococcus complement fixation reaction is described by M. A. Wilson and colleagues ("Coll. Studies, Bur. of Labs., City New York," 1916-1919, p. 486), and by James D. Smith and M. A. Wilson (*Jour. Immunology*, v, No. 6, November, 1920, p. 499). This method is also designed to reduce the anticomplementary quality without reduction of the antigenic property, and combines incomplete extraction by fat solvents with heating to 80° C. The following notes of the method are taken from the article above quoted ("Coll. Studies, Bur. Labs., City New York, 1916-1919, p. 486):—

Scrape the growth from plates or tubes and transfer to a centrifuge tube containing fifty per cent alcohol, stir thoroughly and centrifuge for five minutes' at high speed. Pour off supernatant fluid and add absolute alcohol. Stir thoroughly and place in water bath at 37° C. for thirty minutes, shaking frequently during this period. Centrifuge and remove supernatant fluid, add more absolute alcohol, stir, centrifuge, and pour off supernatant fluid, and continue this washing with alcohol until the supernatant fluid is perfectly clear. Now add pure ether, stir well, and leave at room temperature for thirty minutes, stirring frequently. Centrifugalize and pour off supernatant fluid, again add ether; centrifuge and again remove supernatant fluid. Plug the tube and allow to dry at room temperature in the dark or in the 37° C. incubator. When dry, weigh the powder, and to each ten milligrammes of powder add one cubic centimetre of 0·9 per cent salt solution. The suspension so obtained is tranferred to a sterile, neutral glass flask or bottle and heated for one hour to 80° C. Bottle the product in five-cubic-centimetre quantities and sterilize at 56° C. for one hour on three successive days. The antigen is now ready for use when appropriately diluted—usually 1 in 20 to 1 in 40—as determined by preliminary titration with a known antigonococcus serum.

On preparing an antigen in this way I obtained rather disappointing results, but as this may have been due to a peculiarity of the strain chosen for making the experiment, I do not lay too much stress upon it. The result obtained shows, however, that antigens so prepared do not under all circumstances exhibit anticomplementary action markedly less than do suspensions of the same strain of coccus, whose sole treatment was heating to 56° C. for thirty minutes.

Varying quantities of guinea-pig complement made up to constant volume of 0·1 cubic centimetre were distributed into four sets of ten tubes. 0·1 cubic centimetre of antigen of concentration, as shown in the following table, was added to each, and the volume made up to 0·4 cubic centimetre by addition of saline. These were incubated at 0° C. for six hours, and then 0·1 cubic centimetre of five per cent sensitized human cells was added and incubated for thirty minutes in a water bath at 37° C

	Complement										
	0·1	0·09	0·08	0·07	0·06	0·05	0·04	0·03	0·02	0·01	Control
a. New York prepared antigen, 500 mill. per 0·1 c.c.	+	+	+	+	+	P	T	–	–	–	–
b. Ditto, 250 mill.	+	+	+	+	+	+	+	P	–	–	–
c. Heated to 56° C. for 30 min., 500 mill. per 0·1 c.c.	+	+	+	+	+	P	T	–	–	–	–
d. Ditto, 250 mill.	+	+	+	+	+	+	P	–	–	–	–
e. No antigen, complement 2/5 of that in a, b, c and d	+	+	+	+	+	+	+	P	–	–	–

+ means complete lysis. P means partial lysis.
T means trace lysis. — means no lysis.

The test does not show any superiority of the antigen prepared by the method described over that prepared by simple heating to 56° C., so far, at least, as reduction of anticomplementary quality is concerned. On the other hand, comparison of control series "e," with "a," "b," "c," and "d," shows that neither of the antigens in the concentrations employed is unduly anticomplementary, for in the Fildes-McIntosh method of conducting the Wassermann a ratio of $\frac{\text{activity of complement in absence of antigen}}{\text{activity of complement in presence of antigen}}$ equal to 5 over 2 is permitted and presumably the same might be allowed in the test under consideration, provided the ideal of a non-anticomplementary antigen is unattainable.

Notwithstanding this result, a series of fifty tests was made with serum from clinical cases, using Kolmer's technique, with the "New York" antigen, and really very satisfactory results were obtained.

(ii) Antigens prepared from cocci after ether extraction, and also after ether extraction followed by digestion with trypsin, were investigated in a similar manner, as it seemed possible that such treatment might have the desired effect.

The antigens were prepared as follows:—

A suspension of cocci standardized by the opacity method to contain 5,000 million cocci per cubic centimetre was divided into two parts, "a" and "b"; "a" was treated as for the New York antigen; "b" was centrifugalized at high speed and the deposit of organisms so obtained was transferred to a Soxblet thimble. The material in the thimble was washed with acetone and alcohol to dehydrate, and was then extracted with ether in the Soxhlet for eight hours, after which it was dried and resuspended in saline of volume requisite to make this suspension of the same concentration as "a." Product "b" was now divided into two parts, b1 and b2.

B1 underwent no further treatment.

B2 was dealt with thus: sufficient ten per cent sodium carbonate solution was added to bring the reaction approximately to Ph 7·6 and "Difco" trypsin was added to concentration of one per cent. The trypsinized suspension was incubated at 37° C. overnight, and in the following morning N/100 HCl was added with extreme care until an end point was reached, which just failed to give the least tint of green with a-naphtholphthalein.

With these three antigens were set up tests of their anticomplementary activity.

Complement (guinea-pig serum previously absorbed with sheep cells) in progressive dilutions was mixed with constant antigen, and kept at 0° C. for six hours, whereupon sensitized sheep cells were added, and the tubes incubated at 37° C. for thirty minutes in a water bath as in previous experiment, but sheep cells were used in place of human cells. The following result was obtained :—

	Complement										
	0·1	0·09	0·08	0·07	0·06	0·05	0·04	0·03	·02	0·01	Control
a. New York antigen, 500 mill.	+	+	+	+	+	+	P	–	–	–	–
b1. Ether extracted, 500 mill.	+	+	+	+	+	+	+	+	+	–	–
b2. Ditto and digested, 1,000 mill.	+	+	+	+	+	+	+	+	+	P	–
c. No antigen, complement 2/5 of that in a, b1, b2	+	+	+	+	+	+	+	+	+	P	–

This shows that prolonged extraction with ether does considerably reduce the anticomplementary action of antigen, and provided that this is attained without corresponding loss of fixation qualities, such extraction should prove valuable. The same is true to an even greater extent of the extracted and digested product.

A series of fixation tests was then set up, using these three antigens. The technique employed was as follows :—

(1) Guinea-pig complement, previously absorbed with sheep cells, was distributed for each test in doses of 3 m.h.d., 2 m.h.d., and 1·5 m.h.d., the titration of this reagent being based upon the above results in respect of each antigen.

(2) The sera to be tested were :—

(*a*) Human serum from a case of gonorrhœa showing inguinal adenitis (Wassermann negative) diluted 1 in 5 and inactivated for twenty minutes at 56° C.

(*b*) Normal human serum similarly prepared.

(*c*) Serum of rabbit immunized with gonococcus similarly treated but diluted 1 in 10.

The volume of these sera in the tests was 0·1 cubic centimetre.

(3) The antigens were used in the actual quantities shown in the table.

(4) The hæmolytic system was the same as that in the preliminary test.

The mixtures of serum, antigen and complement, and the corresponding controls of antigens and complement without serum, and of serum and complement without antigen, were made up to volume of one cubic centimetre, and were kept at 0° C. overnight when 0·5 cubic centimetre of the hæmolytic system was added, and the whole incubated for thirty minutes at 37° C.

The following were the results obtained :—

(1) Serum from case of chronic gonorrhœa.

	Complement 3 m.h.d.	2 m.h.d.	1·5 m.h.d.	Comp. 1·5 m.h.d. with antigen and no serum	Comp. 1·5 m.h.d. with serum and no antigen
a. New York antigen, 500 mill.	+	P	—	+	+
b1. Ether extract, 500 mill.	+	P	—	+	+
b2. Ether extract and digest, 1,000 mill.	+	+	—	+	+

(2) Serum from rabbit immunized with gonococcus.

	Complement 3 m.h.d.	2 m.h.d.	1·5 m.h.d	Complement 1·5 m.h.d. with serum and no antigen
a. New York antigen, 500 mill. ..	P	—	—	+
b1. Ether extract, 500 mill.	P	—	—	+
b2. Ether extract and digest, 1,000 mill.	+	P	—	—

(3) Normal human serum.

	Complement 3 m.h.d.	2 m.h.d.	1·5 m.h.h.	Complement 1·5 m.h.d. with serum and no antigen
a. New York antigen, 500 mill. ..	+	P	P	+
b1. Ether extract, 500 mill.	+	+	+	+
b2. Ether extract and digest, 1,000 mill.	+	+	—	+

+ means complete lysis. P means partial lysis. — means no lysis.

Note.—In these tests it was necessary to include a complete set of controls with serum alone in each instance as the m.h.d. was not the same for all three antigens.

These results indicate that:—

(i) With serum from an average case of chronic gonorrhœa showing slight systemic involvement, none of the three antigens tested exhibits marked deviating properties.

(ii) While the following points call for comment:—

(*a*) The most specific results were obtained with the b1 (ether extracted) antigen.

(*b*) The result with normal human serum along with the ether extract digest—b2—antigen in presence of 1·5 m.h.d. of complement is non-specific. This result is important, for it indicates that if we are using an antigen which itself has *any anticomplementary qualities whatsoever*, there is danger of summation effects being obtained when such antigen is mixed with serum. Many sera even in the dilutions employed in the above experiment will account for as much as half m.h.d. of complement even when that m.h.d. is determined in presence of antigen.

(*c*) The sera used in the experiment were diluted as indicated in order to obviate, as far as was compatible with the formation of a deviating couple, the introduction of such summation effects.

(*d*) The slight degree of deviation when the experimental antigonococcus serum was tested in presence of the b2—ether extracted and digested—antigen is interesting. It may be that as Douglas (*Brit. Journ. Exper. Path.*, ii, No. 4, August, 1921, p. 175) suggests these digested antigens might prove of greater diagnostic value under certain circumstances, while those prepared by other methods might be of special value in other circumstances.

(*e*) The criticism applicable to antigens prepared by breaking up the organisms with alkali is equally applicable to antigens prepared by diges-

tion, for accurate neutralization is no less difficult in the one case than it is in the other.

(*f*) In view of the poverty of humoral response in gonorrhœa, it seems probable that any technique which demands dilution of the serum to be tested in order to obviate summation effects, is not likely to give a reaction of sufficient delicacy for clinical purposes.

(*g*) The ideal antigen which, while present in sufficient concentration to give deviation and will at the same concentration exhibit no anticomplementary effect, is worth striving for, as it alone gives hope of the elaboration of a satisfactory technique.

(*D*) *Attempts to prepare Antigens which can be used in High Concentration without at the same time exhibiting any Anticomplementary Quality.*

The investigations summarized in the previous sections of this report draw attention to three points of prime importance :—

(i) That in the first place the complement deviating quality of complexes of gonococcus with antigonococcus serum is not in most instances robust.

(ii) That the deviability of guinea-pig complement by such cemplexes is variable; so demanding only a small excess of complement over the m.h.d., as determined by preliminary titration, in the actual tests, if these are to be sufficiently delicate.

(iii) That the results obtained strongly suggest that summation effects of the anticomplementary action of antigen, plus that of the sera under investigation, may give false positive results when such small excess of complement is present.

Any attempt, then, to render the test sufficiently delicate to be of real value for clinical purposes involves the preparation of an antigen which, exhibiting no anticomplementary qualities, obviates the danger of such summation effects.

(*To be continued.*)

SENTENTIÆ VAGÆ.

By Major M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

(*Continued from p.* 297.)

XII.

In France, stationary hospitals did not appear to play the particular rôle for which they were created. Certain stationary hospitals were established in Army areas, but they catered only for local sick and special types of cases and did not come into the general scheme of evacuation of casualties from front to base. At the bases general and stationary hospitals were practically identical in function. Frequently the stationary hospital was the larger unit. The impression was that the stationary hospital had ceased to play its rôle as a staging unit on the line of communication. Perhaps this impression is correct. On the other hand, the general hospital may have been playing the rôle of the stationary hospital. For the real base was England and the base in France was but a staging point on the journey from the fighting front. If considered in the light of pre-war conceptions and ideas, there is much to be said in favour of this view. It may be carried further, and the base hospitals of France regarded as a rearward line of casualty clearing stations.

XIII.

A useful point about the stationary hospital was its comparative mobility. Though functioning with 1,000 beds, if need be it could shrink to its "G. 1098" scale of equipment for 400 beds and pack itself into a train in a fairly short space of time. It was more mobile than the "super casualty clearing station," which occasionally required two trains to move it. The stationary hospital derived much benefit from the presence of the simple word "hospital" in its designation while the casualty clearing station suffered from the absence of this word. The latter unit was re-christened in early infancy—before its future scope had been fully appreciated—lest the general public might misunderstand its lack of hospitalization facilities. Yet before many months had gone by this primitive evacuation unit had begun a rapid process of development which ceased only with the ending of the war. Far from remaining a mere "station," it became one of the biggest things in hospitals that the war produced. A factor which tended to hinder this development was the absence of the word "hospital" from its designation. Services on which it was dependent did not understand its importance, and difficulty was experienced on this account. Had it been a "hospital" expanding from a given number of beds to double its original size or more, this difficulty would not have arisen as the situation would have explained itself. So much was this in evidence, that the special type of evacuation hospital required for the special type of trench

warfare in France—that is, the "super casualty clearing station"—might have been more easily built up from a stationary hospital foundation than from the primitive foundation of the original casualty clearing station, *née* clearing hospital. The casualty clearing station was designed for a war of movement, not for stationary warfare.

XIV.

As regards the employment of a motor ambulance convoy for active operations, it was most essential to obtain an accurate forecast of its carrying capacity per twenty-four hours in connexion with the particular task it would be called upon to perform. This task was, normally, the evacuation of casualties from one or more main dressing stations to a group of casualty clearing stations. By noting carefully the time an individual ambulance took to complete the round trip by authorized traffic circuits, and allowing time for loading, unloading, refilling with oil and petrol, inspection, driver's rests and meals, and for road congestion, it was possible to find approximately the number of round trips per twenty-four hours per ambulance. This was a most important index. During trench warfare, with conveniently situated casualty clearing stations the number of round trips per twenty-four hours was frequently six, but during the closing phases of the war, with a rapidly advancing front, damaged roads and bridges, and casualty clearing stations far to the rear, the round-trip index slumped. It became as low as one trip per twenty-four hours—sometimes thirty-six hours. Further, a convoy of fifty cars would have a distinct proportion "constantly sick," varying accordingly to the make and age of the cars and to other factors. During the battle of the Somme, the proportion of cars out of action was small, one convoy of which the writer had experience maintained forty-seven cars on the road for several weeks. The round-trip index and the probable number of cars in commission gave the maximum carrying capacity of a convoy in a given time. It was a most useful figure on which to base evacuation calculations for active operations. From it, the amount of additional transport required for the lightly wounded could be forecasted approximately, taking into consideration the nature of the military operations and the distances that casualties would have to be transported. Additional transport to supplement the motor ambulances was required for all battles and was obtained by utilizing Decauville trains, returning empty supply and ammunition lorries which kept to a definite route, canal barges, and specially allotted lorries or 'buses formed into an extemporized ambulance convoy.

XV.

Three objections to the standard type of motor ambulance body were these. First, it could carry only four cases lying, though by load it could take six or more if they were sitting. Thus, if there were no sitting cases available the ambulance was working at only two-thirds of its capacity. Second, the interior was very dusty in summer owing to the faulty

arrangement of the back curtain. A door was required so as to prevent the back draught drawing in dust from the rear wheels, since with a curtain the opening was at the lower part when it was partially rolled up. The opposite was required—the lower portion to be closed, the upper portion open. Third, the stretcher case had only the chassis spring to mitigate ground shocks. In a touring car, the passenger has two sets of springs—those of the chassis and those of the cushions. With the stretcher case there were no cushion springs; he was jolted as much as if lying on the floor of a touring car. The motor ambulance is far from an ideal method of transporting serious cases, but nothing better took its place. The barge was the nearest approach to the ideal but its scope was limited. A sledge dragged behind a tank was remarkably smooth in winter, while the ground was soft, but the employment of tanks for medical purposes had not developed during the war. As pointed out by one committee, the ambulance train developed out of all recognition during the war, while the motor ambulance body of 1918 was identical with that supplied in 1914. This is the case. With the exception of a heating apparatus, which was sound in principle if not perfect in practice, no improvements were introduced. There were under consideration at least two designs for additional stretcher springs—but the war ended first.

XVI.

There was an idea that the unit of fifty cars with workshop complete was too small and uneconomical, since one workshop might have done for 100 cars. Possibly it might, but one workshop for 100 cars would have meant nearly double the number off the road awaiting repair. It would have been one of those economies—the saving of workshop personnel, etc. —which cost the taxpayer dear. One essential of an efficient motor ambulance service was a workshop which could undertake rapid repairs, be able to carry out efficient inspection, and whose objective was to keep each of the fifty cars in good running order. To double the number it had to attend to would cripple its initiative and turn it into an indifferent garage. Its work, like ours, was largely preventive. With 100 cars this would have been impossible.

XVII.

The medical service of our Allies the French contained much of interest. In many ways their hospital equipment was superior to ours. For instance, they possessed a better type of tent. The Bessonneau tent was extremely portable, well lighted and commodious, with a capacity equal to about three of our small hospital marquees. Broadly speaking, it consisted of an easily erected framework over which the canvas was stretched, the inner lining being put up afterwards. Oblong in shape, with windows on each side and doors at the ends, for portability, ease of pitching and striking, and adaptability to present-day requirements, it had the hospital marquee out-classed completely. The French possessed

portable operating huts carried on special motor lorries, complete even to heating apparatus, and capable of erection in little over an hour. They had sterilizing lorries, laundry lorries, motor kitchens, electric lighting lorries and the like—also hangars for use as reception tents. Much was to be learnt from a study of their equipment and organization. It was from a combination of the above motor equipment that the "Auto-Chir" was evolved. The "Auto-Chir" was a mobile surgical unit of 200 beds, completely equipped with motor transport, which was and probably still is the last word in mobile hospitals for major surgery. A detailed account of this unit would be of considerable interest. We had nothing like it. It was assembled only towards the close of the war and was not fully developed when the end came.

XVIII.

The French hutted "Hospital of Evacuation" was a very complete installation, down to its "Javellized" water supply. It consisted of double-lined wooden huts connected together by covered passage ways, with a covered-in railway siding right in the hospital. Its accommodation might be as much as 2,000. The section of the hospital which dealt with walking wounded had rows upon rows of pew-like benches, with narrow tables in front of each. Down one side of the long Adrian hut was a sloping platform covered with mattresses or straw, on which patients could lie down. Seating accommodation and lying accommodation for lightly wounded passing through was thus supplied on a generous scale. A line of these hospitals was established at casualty clearing station distance, with a second line about ten miles in rear. A hospital of evacuation was not a definite unit like a casualty clearing station. It was an institution staffed by a varying number of "pooled" field medical units, plus such additional surgical staff as was required. The French recognized and catered for an "intransportable" type of serious case, which became hospitalized at main dressing station or casualty clearing station distance from the line and remained in a forward medical unit for weeks or months, until fit for transfer. They went in for "Triage" and were constantly sorting out cases right down the line. They possessed proper hospital accommodation up in army areas; for instance, during the battle of the Somme, in addition to some thousands of beds in Amiens, they had several thousands in their evacuation hospitals east of that city. We had only our casualty clearing stations in which to hospitalize cases in the forward area and accommodation would not permit of this on a generous scale. Yet the "intransportable" class of serious case does exist, and more provision may have to be made for it.

XIX.

The British evacuation unit carried on with less elaborate gear than the evacuation units of our Allies. Save for X-ray lorries, mobile laboratories and dental units—the last a gift—we were lacking entirely in the automobile medical equipment of the French. Our First Army, in

particular, studied the question of mobile casualty clearing stations, and constructed a limited number of Wallace-Cowell trailers. A few casualty clearing stations made makeshift demountable huts for theatres or X-ray rooms. It is a matter of regret that these efforts towards mobility did not receive more general attention. Whether we were handicapped by the absence of elaborate gear or not is a difficult question to answer. If we were not handicapped, we might have been so. Our evacuation unit was not particularly mobile, but great mobility was seldom required, even in the last phase when trench warfare had given place to a war of movement. For under the conditions then prevailing, the evacuation unit could not function fully in advance of railhead, and semi-mobility was almost sufficient to keep pace owing to the destruction carried out by a retiring enemy. In any case, we got results which no nation could surpass; our "delivery of the goods" was excellent. During the lean years before the war we had cultivated extemporization up to a fine art. Many of our best installations appeared to be built from ration boxes, oil drums, petrol tins and other makeshift material. They were singular illustrations of how to fashion something out of nothing. This was a point which impressed the foreign visitor to our areas. Nevertheless, if mobility is required in future much re-organization will have to be done and automobile equipment obtained. A new type of tent is essential, for the largehospital marquee is unsuitablefor modern military, medical and surgical requirements. Gloomy by day, and requiring artificial light when closed, ill-ventilated by night, taking the maximum number of men maximum time to erect, these marquees have too long survived the Victorian surroundings for which they were designed. Towards the latter half of 1918, the provision of tents of the Bessonneau type had been decided upon—again the war ended first.

XX.

In 1918, after Foch had been appointed generalissimo, the British, French and American formations were becoming interchangeable. French Corps were in our area, British Corps in the French area and American Divisions in both. Thus a British casualty clearing station might have to take over at short notice from a French hospital of evacuation, or the French unit from a British tented casualty clearing station. It was obvious that the question of standardizing the evacuation units of the Allies would have to be taken up. Though a big task, it would have been worth while creating a standardized clearing casualty station evolved from what was best in the existing units of the Allies. All would have derived much benefit from a fusion of ideas. The object in view was to approximate the evacuation units in equipment, personnel, tentage, organization and interior economy, so that American, Belgian, French or British evacuation units cauld take over from each other at short notice aud with little inconvenience. The problem of standardization, however, was never solved—once again the war ended first.

XXI.

It was interesting to watch the growth of surgical *liaison*. In the early days there were bound to be " watertight compartments " in the medical services of the Expeditionary Force, for the medical units had little intercommunication and individual experience might be limited to one particular type of unit. And the unique conditions of war surgery were not fully realized everywhere. The field ambulances, the casualty clearing stations and the general hospitals had not appreciated the different rôle which each was called upon to play in the general scheme of treatment and evacuation. Official complaints of indifferent treatment, or alleged indifferent treatment, on the part of medical units farther up the line were not uncommon. Many were due obviously to lack of knowledge of the conditions prevailing in the forward area, and of the limited scope for surgery in that area. As time went on the watertight compartments were gradually broken down until towards the close of the war they were completely swept away and the whole surface rendered homogeneous. Many factors assisted in the sweeping away of these compartments. The casualty clearing station commander of 1914-15 had been promoted A.D.M.S. of a Division and his place at the casualty clearing station taken by a field ambulance commander. The presence of A.D's.M.S. with casualty clearing station experience was of great administrative benefit, and this of itself helped in great measure to bring about a closer *liaison* between the casualty clearing stations and the medical units of Divisions. Officers of field ambulances moved to casualty clearing stations; many of the casualty clearing station surgeons had done field ambulance or regimental medical duties on first arrival in France. Considerable interchange of officers between bases and field formations took place constantly. Again lectures, conferences and clinical meetings were held and the consulting surgeons of armies and bases began to control the surgery and formulate a definite surgical policy. Under their auspices surgery became an organized subject. They were in close touch with each other; new methods and ideas were " broad-casted " as they became known. Surgeons up and down the line and at bases tried these new methods and adopted them, improved upon them or "turned them down" as the case might be. The duties of the consulting surgeon increased. He began the war as a consultant pure and simple who saw the individual case in consultation as in civil life. He advised on such matters as the provision of surgical equipment. Later on, though he still continued these duties, he was in addition an important administrative officer who held in his hands the control and direction of military surgery in the formation to which he was attached. In effect, he was A.D.M.S. surgery.

XXII.

In the latter half of the war *liaison* improved enormously. Consulting surgeons were then visiting field ambulances and looking upon the forward units, main dressing stations and advanced dressing stations as places

where their advice and experience were required. Officers with surgical training at these stations would be sent for temporary duty to the casualty clearing stations. The casualty clearing station surgeons exchanged duties during quiet periods with those of the general hospitals. In this manner the last of the watertight compartments in France were swept away. And it was about this period that the greater watertight compartment became visible. It separated the hospitals in France from those in the United Kingdom, and the problem was how to break it down, as the surgeon in France and the surgeon at home were not interchangeable. The former was young and fit, and could not be spared for home; the latter was not available for France. He might be unfit for general service. The solution of the problem was to send the home surgeon on a "joy-ride" round the general hospitals and casualty clearing stations in France, in order that he could see conditions for himself and get in touch with the surgeons who sent him his cases. This was commenced in 1918 with very good results.

XXIII.

The prognosis of war casualties is difficult, and prognosis is a branch of medicine which does not receive much attention from the British Faculty. For military work in France a good sense of prognosis was most invaluable. It was only too frequently that one found in field ambulances, for example, cases retained for treatment which were not likely to be fit for several weeks or months. The retention of such cases militated against their early recovery, and excluded from treatment the type of case with which the field ambulance could deal. Prognosis appears to be better developed in other countries. It is an important feature of war medicine and surgery, and one which the military medical officer should cultivate.

XXIV.

Economy attacked several branches of the Medical Services but did no serious harm. It opposed the provision of X-ray apparatus to casualty clearing stations, but withdrew its opposition in presence of the weighty arguments brought forward by distinguished surgeons, who showed that primary suture could not be carried out without a good X-ray plant, and that an X-ray apparatus, if it resulted in saving the life of one British soldier, had repaid in actual money its original cost. But with the exception of the hospital dietary, economy was kept under proper and sensible control, though it gained a minor victory in compelling Colonial nursing sisters to pay for the thermometers they broke in the wards. The plain truth is that economy has eaten into our souls during decades of peace conditions, and we cannot be really extravagant if we try. The Medical Service in France was most economically run and there was little unnecessary waste. A Service should never be "stingy." For stinginess is expensive in the long run as it leads towards lessened *moral*. This is a point which requires attention at the present day when the psychological factor

in efficiency is recognized. Among certain classes of soldiers, as in a lesser degree among domestic servants, stinginess is looked on as a vice. Anyone who practises it loses a certain degree of respect. "Largesse" is a virtue; those who practise it rise in the esteem of their fellows. Herein lies the secret of the efficiency value of an issue of rum. The fact that the Government is "standing free drinks" makes the soldier feel that it is pleased with him and is doing its best for him. This is "largesse" which he appreciates; the *moral* of a force is improved by the issue, provided of course that the issue is properly carried out. The toxic effects of alcohol on the human body appear to be of lesser importance in considering the pros and cons of the rum issue than its psychological effects. In economy the psychological effects must be kept in view also. The writer is no advocate of waste or extravagance; but there is a difference between economy and downright stinginess which is sometimes hard to detect One lesson of the last war was the need for keeping economy within reasonable, sensible and just limits. *It is a lesson which we should not forget.*

XXV.

Economy in peace time is absolute; in war it must be relative. During peace it is inevitable and, like the poor, is always with us. In the years of peace we become accustomed to its constant presence; it cramps our style and prevents or delays many reforms. Herein arises one of the obstacles which the administrator may find difficult to surmount. After years of constant economy comes a sudden call to war. He must have retained considerable mental flexibility if he is to cope successfully with the new situation. For instead of the old reply, "You cannot have it," comes a new command—"Ask for what you want and you shall have it." The administrator is much in the same position as a pauper who is suddenly called upon to furnish a country house. Peace administration and war administration are as opposite as the two poles; one affords little training for the other. There is and must be a good war mind and a good peace mind, and it is almost unreasonable to expect to find both combined in one ordinary individual. A clever war administrator may find his initiative cramped in peace. An officer trained in peace administration will soon discover that the problems of war are difficult to solve in time of peace The wide mental outlook required for war can be developed in peace time only by studying the problems of war. The details and minor matters of peace time routine can have but little influence on the development of that flexibility of mind which enables an administrator to forget his peace restrictions and think in terms of war. The old peace time maxim was "Don't let 'em have it." This summed up the necessity for rigid economy, and within reasonable limits it was a sensible maxim. On mobilization it must be recognized as totally inapplicable and even dangerous; economy must give place at once to liberality. For war administration the best motto is "Deliver the goods."

JAUNDICE OCCURRING AMONGST BRITISH SOLDIERS ON THE RHINE, WHO HAD RECEIVED TREATMENT WITH ARSENOBENZOL COMPOUNDS.

By Major P. Power,
Royal Army Medical Corps.
Specialist in Dermatology, British Army of the Rhine.

The figures given in this article have been compiled from patients on the Syphilis Register at No. 25 General Hospital, Cologne, for the thirteen-month period from January, 1922, up to January, 1923, both months inclusive.

Since the autumn of 1920, jaundice following treatment with "914" and mercury has been more or less prevalent amongst the British Garrison on the Rhine, and Todd reports on fifty-three such cases which occurred during the period, March, 1920 to July, 1921, amongst British troops stationed in Cologne. These fifty-three cases occurred amongst 660 patients undergoing treatment for syphilis.

During the last few years much controversy has centred round this disease, which appears to be on the increase. Although in the majority of such cases the attack is mild it sometimes goes on to acute yellow atrophy of the liver with rapidly fatal results, therefore I think it may not be amiss to publish the following article on this most interesting subject.

Before doing so it would perhaps be better to point out that in this series of thirty-five cases some developed jaundice within a few days after receiving an injection of "914" and mercury (early benign cases). Others developed the attack after a much longer interval following their last injection. The question may well be asked, Are all these cases true toxic jaundice ones following on and caused by the administration of arsenobenzol in syphilis patients? This is difficult to answer. Widal's hæmoclasic reaction gave a persistent positive result in those cases where it was performed, but owing to pressure of work and the time expended on this test it was only done in a limited number of cases. This would suggest that the disease was not ordinary catarrhal jaundice. Again the jaundice in this series of cases was severe and more marked than is usually the case in the ordinary catarrhal condition, the average duration of stay in hospital for each case being 55·74 days. Literature on toxic jaundice following administration of arsenobenzol compounds suggests that the interval between the last injection and the onset of jaundice can run into months. For instance Silbergleit and Fockler report upon eight cases of jaundice occurring some thirty-eight to 103 days after the last injection of the arsenobenzol compound. They also report upon thirteen cases of "acute yellow atrophy" all occurring several weeks after the cessation of treatment.

Herxheimer reports upon six fatal cases of acute yellow atrophy of

liver occurring in patients 3 to 8 weeks after the last injection of an arsenobenzol compound. Again during the Great War several cases of poisoning by trinitrotoluene were recorded in which the jaundice, one of the most prominent symptoms, occurred many months after all work with trinitrotoluene had ceased. Although I am of opinion that the jaundice in these thirty-five cases of syphilis was not an ordinary catarrhal condition, it is difficult to say what the actual cause was. I am of the opinion that the drug in use is not the sole cause, but that there appears to be some other causative agent acting on a liver already deranged owing to treatment with the arsenobenzol compounds, perhaps bacterial infection.

During the period in question, 768 men were on the Syphilis Register either under observation for syphilis, or receiving treatment for this disease.

Of this total thirty-five suffered from jaundice at a short or a long interval following the administration of "914" and mercury. This gives a percentage of 4·55, a higher percentage than is usually recorded in this disease. The Medical Research Council in their Special Report Series, No. 44 of 1915, give a percentage of 0·56 taken from 39,377 cases of syphilis.

The above percentage figure, 4·55, actually refers to cases of jaundice occurring amongst these 768 syphilis patients whilst they were stationed on the Rhine, and within this given period of thirteen months.

The Mayo Clinic in America give a percentage of 1·3 taken from 5,200 syphilis patients.

Jaundice in syphilis patients, however, appears to be more prevalent and more apt to occur amongst British troops on the Rhine than amongst our troops in Home Garrisons. The reason why this should be so is difficult to explain. During the period in question there were in addition ninety cases of catarrhal jaundice unconnected with the administration of arsenobenzol compounds. The average monthly strength of the British Garrison for this period was approximately 6,578.

Jaundice appears to be prevalent in Germany and is stated to be more prevalent in Northern Germany than in the South. The average duration of stay in hospital for these thirty-five cases treated for jaundice works out at 55·74 days each.

Table "A" shows stage of syphilis on commencement of treatment when patient was first placed on the Syphilis Register, the quantity of "914" and mercury administered in each case prior to the onset of jaundice and the interval between the last dose of "914" and admission to hospital for this complaint.

In all cases the dosage of "914" is given in grammes administered intravenously and that of mercury in grains administered intramuscularly, the latter drug being given in the form of mercurial cream.

Of these 35 cases, 18 received neokharsivan without any other arsenical preparation, 13 received both neokharsivan and novarsenobillon, whilst the remaining 4 received novarsenobillon only. All these cases received mercurial cream in addition as can be seen by reference to Table "A."

During this thirteen months period, 284 injections of neosalvarsan with mercury were given and no jaundice occurred following the administration of this arsenobenzol compound.

Of the thirty-five cases, thirty-one received neokharsivan either alone or with novarsenobillon. Neokharsivan has not been in use at No. 25 General Hospital since July, 1922.

TABLE "A."—TABLE SHOWING STAGE OF DISEASE (SYPHILIS) ON COMMENCEMENT OF TREATMENT, QUANTITY OF "914" AND MERCURY GIVEN PRIOR TO ONSET OF JAUNDICE, AND INTERVAL BETWEEN LAST INJECTION OF "914" AND ADMISSION TO HOSPITAL FOR JAUNDICE.

Serial No. in Syphilis Register	Stage of syphilis when treatment commenced	Total quantity of "914" and Hg administered prior to onset of jaundice	Interval between last injection of "914" and admission to hospital for jaundice
795	Late primary	NK 3·75 grm., Hg 6 gr.	78 days
823	Early primary	NK 4·20 grm., Hg 5 gr.	8 ,,
822	Late primary	NK 3·75 grm., Hg 7 gr.	60 ,,
834	Early primary	NK 3·75 grm., Hg 6 gr.	40 ,,
824	,, ,, ...	NK 3·75 grm., Hg 7 gr.	85 ,,
687	Late primary	NK 7·05 grm., Hg 12 gr.	95 ,,
887	Early primary	NK 2·55 grm., Hg 5 gr.	37 ,,
832	Late primary	NK 6·30 grm., Hg 11 gr.	7 ,,
875	,, ,, ...	NK 3·15 grm., Hg 4 gr.	89 ,,
986	Early primary	NK 3·75 grm., Hg 7 gr.	157 ,,
910	Late primary	NK 3·75 grm., Hg 7 gr.	98 ,,
972	,, ,, ...	NK 3·75 grm., Hg 7 gr.	69 ,,
964	,, ,, ...	NK 3·75 grm., Hg 3 gr.	68 ,,
1,074	,, ,, ...	NK 1·35 grm., NAB 1·20 grm., Hg 5 gr. ..	14 ,,
872	,, ,, ...	NK 3·75 grm., Hg 7 gr.	43 ,,
956	,, ,, ...	NK 3·75 grm., Hg 7 gr.	101 ,,
965	,, ,, ...	NK 3·75 grm., NAB 1·35 grm., Hg 10 gr...	5 ,,
1,021	Early primary	NK 3·75 grm., NAB 0·90 grm., Hg 7 gr. ..	33 ,,
1,104*a*	Late primary	NAB 3·75 grm., Hg 7 gr.	7 ,,
977	Early secondary ..	NK 2·55 grm., Hg 4 gr.	140 ,,
1,043	Early primary	NK 3·75 grm., NAB 0·90 grm., Hg 7 gr. ..	40 ,,
1,050	Late primary	NK 1·35 grm., NAB 1·20 grm., Hg 5 gr. ..	76 ,,
1,038	,, ,, ...	NK 3·15 grm., NAB 1·05 grm., Hg 8 gr. ..	1 day
994	,, ,, ...	NK 3·75 grm., Hg 7 gr.	118 days
1,031	,, ,, ...	NK 3·75 grm., NAB 0·90 grm., Hg 9 gr. ..	5 ,,
1,032	Early primary	NK 3·15 grm., NAB 1·50 grm., Hg 7 gr. ..	48 ,,
1,037	Late primary	NK 3·75 grm., NAB 0·45 grm., Hg 8 gr. ..	22 ,,
1,055*a*	Early primary	NK 1·35 grm., NAB 3·30 grm., Hg 6 gr. ..	27 ,,
1,058	,, ,, ...	NK 3·15 grm., NAB 1·50 grm., Hg 7 gr. ..	85 ,,
917	,, ,, ...	NK 4·65 grm., Hg 7 gr.	164 ,,
996	,, ,, ...	NK 1·35 grm., NAB 3·30 grm., Hg 6 gr. ..	44 ,,
1,010	,, ,, ...	NK 3·75 grm., NAB 0·90 grm., Hg 7 gr. ..	125 ,,
1,161	Late primary	NAB 3·75 grm., Hg 7 gr.	64 ,,
1,144	,, ,, ...	NAB 3·75 grm., Hg 7 gr.	72 ,,
1,200	,, ,, ...	NAB 3·75 grm., Hg 7 gr.	117 ,,

Of the 35 cases alluded to, 13 were in the early primary stage with a negative Wassermann blood throughout, 21 were in the late primary stage and only 1 in the early secondary stage. This would tend to demonstrate that syphilis in itself is not the cause of jaundice, for if so then one would expect to see a larger proportion of cases occurring amongst the later syphilides, such as florid secondaries, where the toxins of syphilis are more abundant and widespread throughout the tissues of the body. An

additional proof that syphilis itself is not the cause lies in the fact that of the 35 cases recorded herein, 29 gave a negative Wassermann reaction at the test last done prior to onset of jaundice, 3 gave a strong positive reaction, 1 was positive and 2 partially positive. Again, jaundice in syphilis cases prior to treatment with arsenobenzol does not appear to be as frequent as in recent years. Werner, in 1899, gives the percentage as 0·37 amongst 15,799 cases of syphilis; of course these never had arseno-benzol treatment.

The jaundice does not appear to be due to an overdose of arsenic. By scrutinizing Table "A" it will be seen that in Serial Nos. 887, 1,074, 977 and 1,050, jaundice occurred after the administration intravenously of 2·55 grammes of "914" in each case, these injections being spread out over periods of 75, 40, 42 and 43 days respectively, not large doses for this organic preparation of arsenic. Just recently I have seen a case of syphilis develop an acute attack of jaundice after receiving two intravenous injections of novarsenobillon consisting of 0·45 gramme each, with one week's interval between the two. There are also other cases on record to show that the disease may appear after a small total dosage of 0·90 gramme of an arsenobenzol compound given to a syphilis patient.

Again if the disease is entirely due to the arsenobenzol compound then it would appear to be dangerous to repeat the drug at a short interval after recovery. I have not found any danger in doing so. In fact in several cases treatment with "914" and mercury was recommenced within a few days after the patient was discharged hospital for jaundice. For instance, Serial Nos. 795 and 834 commenced treatment again two days after discharge from No. 3 General Hospital, having suffered from jaundice. Serial No. 1031 recommenced treatment within seven days after discharge from hospital and went straight through with a 5/6 course (5/6 equals: 5 injections of "914" and 6 injections of mercury with weekly intervals). Serial Nos. 687, 1,074 and 872 started treatment 21, 20 and 12 days after discharge from hospital for jaundice and went straight through 6/7, 5/3 and 6/7 courses respectively without the slightest trace of the recurrence of their jaundice and without any untoward result.

Surely this is evidence to show that the drug is not the sole cause of jaundice in syphilis patients. Herxheimer and Milian find no danger in giving further treatment with arsenobenzol after this disease. Again, jaundice does not appear to be due to cumulative action on the part of the arsenobenzol compound in use, as the disease has been shown to occur after a very small dose—0·90 gramme of "914." Again, if due to cumulative action, then the disease ought to be more frequent in cases receiving the arsenobenzol compound intramuscularly than when administered intravenously, as in the former method arsenic appears to be excreted more slowly from the system; however jaundice appears to occur just as frequently when "914" is given by the intravenous route. It may be that this obscure form of jaundice is not due to any one source but caused by several factors all acting in unison, the chief of these being (1)

Syphilis, (2) Treatment with arsenobenzol compounds, (3) Personal susceptibility on the part of the patient, and, perhaps in addition, (4) Bacterial infection, which travels up from the intestines in the form of an ascending cholangitis. Some years ago when stationed in Wellington, Southern India, I was much impressed by the number of paratyphoid patients returning from active service in Mesopotamia with jaundice as a complication, cases in which there was no history of syphilis. Alcohol may be a predisposing factor in the causation of these jaundice cases, as alcohol in itself has action on the liver cells, and then arsenobenzol compounds containing arsenic may overcome a weak-resisting liver causing insufficiency of the hepatic cells, etc., and jaundice. On the Rhine where this jaundice is prevalent alcohol is cheap and freely indulged in by the British soldier in the form of beer and a special decoction called "green light," a mixture of several ingredients much fancied by our troops. Against the theory of alcohol being a predisposing cause is the fact that of this series of thirty-five cases no fewer than seven were total abstainers. Amongst this series of cases ten, or 28·57 per cent, had, previous to the onset of jaundice, received intramine intramuscularly; this suggests that intramine is not a preventive as laid down in some books.

The cases occurring on the Rhine were spread over a wide area, and not confined to any separate unit nor to any special barracks. The disease did not arise in any special batch number of the arsenobenzol compound, and therefore does not appear to be due to toxicity on the part of the drug.

The danger signal of a commencing erythema in a sensitive patient was not seen in the thirty-five cases dealt with in this article, although this physical sign was carefully watched for. Eczema of the scrotum and legs however did occur in one of these patients. Stomatitis was present in seven cases, or twenty per cent. In my opinion stomatitis is not necessarily a precursory warning of following jaundice, in fact stomatitis is apt to occur in all cases receiving mercury, especially where the teeth are carious and in those patients who do not attend to the hygiene of their mouths. It is, however, a symptom not to be entirely ignored. Preliminary symptoms are often conspicuous by their absence, some patients not knowing they were jaundiced until told by a comrade; others have certain physical signs and symptoms, the most common of which are:—

(1) A gradual loss of weight.

(2) Malaise and loss of appetite.

(3) Nausea; frequently this occurs without vomiting, and comes on independently of the taking of food, often in the morning before breakfast.

(4) Tenderness over the epigastric area.

(5) Anæmia.

(6) Dislike for fatty foods.

These symptoms occur early before the sclera turn yellow. With reference to the loss of weight the usual thing is for the patient to put on weight when treatment is commenced, then this stops and patient

gradually commences to drop a little weight weekly. This was marked in several of the cases in Table "A."

In twenty-eight cases no stomatitis was present up to onset of the jaundice. In seven cases stomatitis was present but not severe.

Widal's hæmoclasic reaction (leucocyte count before and after a meal) appears to be an important test to discriminate between this disease and ordinary catarrhal jaundice, when it gives a persistent positive reaction as tested on more than one occasion before and after a meal. Prognosis in the majority of cases is good, especially in early benign cases. The attack is more severe in late cases, and is very grave in those cases developing acute yellow atrophy of the liver. Serial No. 1,161 is an example of this latter condition, and this case is fully reported upon at the end of this article. Prognosis is good in those cases which lie up early and receive proper diet and treatment. Intestinal hæmorrhage is a grave sign and generally seen in those fatal jaundice cases with acute yellow atrophy of the liver.

Treatment.—Rest in bed. Carbohydrate diet without fats and with very little proteid. Glucose internally and large doses of sodium bicarbonate, as well as mild laxatives. A general anæsthetic should not be given in such cases. If chloroform has to be given for any reason glucose should be given before and after administration of the anæsthetic.

There is one type of jaundice where a diagnosis of scarlet fever is apt to be made, namely in those acute cases coming on quickly a few days after an injection of "914." Patient suddenly becomes ill with headache, vomiting and fever, then a couple of days later out comes a profuse small papular scarlatiniform rash all over the body resembling the boiled lobster appearance of scarlet fever, but without the strawberry tongue and without the circumoral pallor; such cases have been erroneously diagnosed as scarlatina. These cases within a few days show all the signs of jaundice, which confirms the diagnosis.

By kind permission of the Officer Commanding No. 3 General Hospital and of Captain A. S. Blackwell, Royal Army Medical Corps, I am allowed to publish notes and post-mortem result on one fatal case of jaundice following arsenobenzol treatment at No. 3 General Hospital, Cologne, in January, 1923. This case is alluded to in this article under Serial No. 1161.

I had no chance of seeing this man during his illness in January, being on leave in England at the time.

Clinical Notes and Post-Mortem Result of Serial No. 1161, who Died of Jaundice following Administration of "914" and Mercury.

History prior to Onset of Jaundice.—The patient came under treatment for late primary syphilis (his first attack of venereal disease) on September 9, 1922. He commenced treatment on the same date and completed a

"B" course on November 15, 1922. This course consisted of 3·75 grammes of novarsenobillon and eight grains of mercury. Patient showed no intolerance to the drugs and put on weight, urine was free from albumen throughout this treatment. After his course on November 22, 1922, his blood gave a negative Wassermann reaction.

History of Fatal Attack of Jaundice.—Patient was admitted to No. 3 General Hospital on January 17, 1923. He stated that he noticed his eyes yellow for some three or four days previous to admission. Patient examined: no tenderness over epigastric area, slight nausea, spleen not enlarged. Placed on fat-free diet, with mist. rhei co. by mouth. January 21, 1923: Jaundice now more marked, occasional nausea, has vomited a few times since admission. Liver appears diminished in size. Leucocyte count fasting and after food gave a positive Widal's hæmoclasic reaction. January 25, 1923: No improvement, pulse running slow, 52 to 58 per minute. January 28, 1923: Patient's condition worse, jaundice now deeper, vomiting more persistent. Urine loaded with bile pigment, albumen and casts present. Severe pain complained of in the epigastric area. Patient taking sod. bicarb. grains 30 quartis horis. Patient on "seriously ill" list. January 29, 1923: Condition worse, still vomiting and becoming drowsy. Lies curled up in bed, resents all interference. Bowels not open to-day nor yesterday. Calomel grains 3 given. Pulse still slow, 56 to minute. The sharp lower edge of liver can be felt on inspiration, only a little urine now being passed. Patient on "dangerously ill" list. January 30, 1923: No urine passed since 15·00 hours yesterday, has not vomited during the past twenty-four hours. Semi-conscious. Skin dry and hot bottles in blankets resorted to in order to produce sweating, which had the desired effect. Pulse now quicker, 78. Twenty ounces urine drawn off with catheter. Urine contains many epithelial and granular casts. General rigidity of body. No retraction of neck, knee-jerks increased. Babinski's sign present. Abdomen rigid and apparently tender, resents being moved or touched anywhere. Pulse in the afternoon became rapid (148 per minute). Bowels constipated, enema given but no result; followed by croton oil one minim. Towards the evening Cheyne-Stokes respiration set in. Patient comatose. Pulse gradually failed. Died at 19·00 hours. Temperature never rose above normal.

Result of Post-mortem Examination carried out Seventeen Hours after Death.—Body: Fairly well nourished. Deeply jaundiced. Rigor mortis passing off. Head: Brain and membranes bile-stained. No naked-eye lesions to be seen. Chest: Left lung congested, adherent throughout to the parietal pleura and diaphragm. Visceral pleura thickened. Right lung congested, otherwise normal. Pericardium: Normal. Heart: Normal size, all valves competent, apparently healthy. Abdomen: No free fluid, numerous small petechial hæmorrhages in the mesentery of small and large intestines. A few petechiæ seen in parietal peritoneum—especially in pelvis Stomach and intestines normal. All organs bile-stained. Liver: Small

less than half the usual size. Substance soft but not diffluent. Mottled greenish brown. Lobules clearly marked, almost like nutmeg liver. Spleen: Normal in size and consistency. Pancreas: Appears normal. Kidneys: Normal in size. Cortex pale, capsule stripped easily. Sections of liver, kidneys, pancreas and spleen were sent to the Royal Army Medical College, London, and very kindly examined by Lieutenant-Colonel Marrian Perry, R.A.M.C., Professor of Pathology, whose report on the histological changes found is as follows :—

"Sections from the various organs—liver, spleen, pancreas and kidneys, were treated by Levaditi's method for demonstration of spironemata. The result in each case established the absence of these organisms.

"*Histological Investigation.*—Kidney: The sections demonstrated considerable vascular engorgement, with, in the greatest part of the organ, areas of interstitial hæmorrhage. The chief pathological changes were noted in the epithelium lining the convoluted tubules. The epithelial cells of the tubules were very evidently affected by cloudy swelling, granular degeneration, or a mixture of both. The lumen of some of the tubules was blocked by desquamated epithelium, leucocytes, or collection of red blood-cells. The changes were such as would classify the condition as an *acute diffuse tubular nephritis.* Pancreas: No changes of any importance were evident in this viscus. The various cellular elements were clearly defined, and no indication of hæmorrhagic or other variety of pancreatitis was present. Spleen: No changes of any importance from normal were noted. Liver: The histological changes in this organ were widespread and most striking. The usual microscopic appearance of the living tissue had undergone complete metamorphosis, and but for the fact that the characteristic features of the bile ducts were evident, difficulty would have been experienced in recognizing the fact that the sections had been made from hepatic tissue. The liver lobules were completely disorganized, the majority of the cells had become completely necrotic, and were replaced by a disintegrated debris of cells. In a few scattered areas some more or less normal hepatic cells were evident, and many of these cells showed two or more nuclei. These are apparently cells which have escaped the toxic action and are evidencing signs of active proliferation. In the larger area the structure consisted of the surviving connective tissue of the organ with its blood vessels and masses of the granular debris referred to above. As has been noted the bile ducts were a prominent feature in these areas. The condition bears a close resemblance to the changes met with in sub-acute yellow atrophy or to the appearance encountered in the organ in fatal cases of infective jaundice."

FIG. 1.

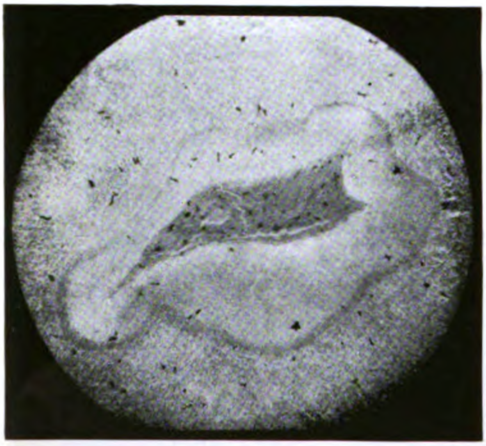


FIG. 2.

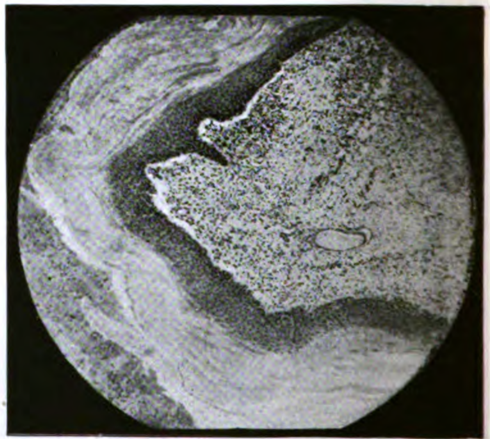


FIG. 3.

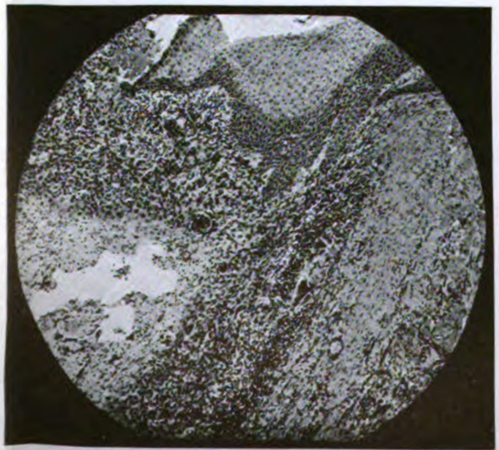


FIG. 4.

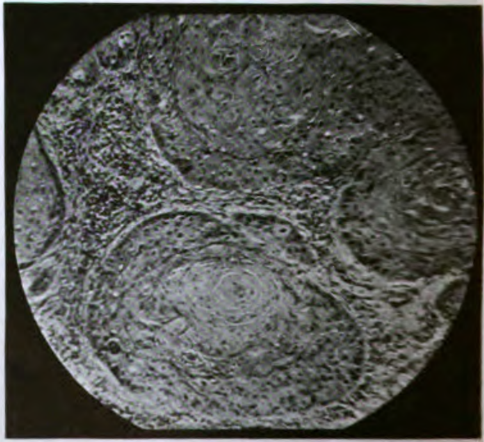


FIG. 5.

To illustrate "Epidermization of the Transitional Epithelium lining the Pelvis of the Kidney, followed by Squamous-celled Carcinoma, and other Changes," by Major J. A. MANIFOLD.

EPIDERMIZATION OF THE TRANSITIONAL EPITHELIUM LINING THE PELVIS OF THE KIDNEY, FOLLOWED BY SQUAMOUS-CELLED CARCINOMA, AND OTHER CHANGES.

By Major J. A. MANIFOLD, D.S.O.
Royal Army Medical Corps.

The following notes of a new growth of the kidney are thought to be of sufficient interest to be placed on record, as some unusual pathological features were noted in the neoplasm.

The kidney was removed from a patient aged 52, who had suffered from chronic pyonephrosis. When the organ was prepared for microscopic slab sections there was found, in addition to the pyonephrosis, a growth of new tissue apparently originating in the pelvis of the kidney, which called for further investigation.

Macroscopic Appearance.

The small portion of unaltered renal tissue which remained almost encapsuled a growth about the size of a small orange situated in the renal pelvis. In its substance a few scattered cysts were evident. Some of these cysts were lined with a layer of white tissue and their contents were flesh coloured, in others, only partially so lined, the contents were greenish in colour (fig. 1).

Microscopic Appearance.

It was found that the normal transitional lining epithelium of the pelvis of the kidney had undergone complete metamorphosis, having taken the character of surface epithelium; the stratified layer being well formed, and extensively keratinized.

Portions of this stratified epithelium infiltrated the kidney substance. The cells in the centre of the infiltrating columns became clear, swollen and finally keratinized, thus forming microscopic cysts filled with keratin (fig. 2). It was apparent that these minute cysts were an early stage in the formation of the larger cysts containing the flesh-coloured material. These larger cysts demonstrated on section the same well formed stratified squamous epithelium. Keratinization was a marked feature and the contents were mainly scaly shreds of keratin and some pus cells (fig. 3). On the other hand the epithelium of the pelvis of the kidney is seen to be invaginated at the expense of the kidney substance, and sections across the tips of these invaginations might give the appearance of cysts in the kidney (fig. 1). From the basal layer of epithelium lining some of the cysts, cells carcinomatous in type were found extending into the kidney substance. The cells in the centre of these infiltrating masses showed evidence of keratinization and degeneration (fig. 4).

The new growth occupying the pelvis of the kidney was found to be a

typical squamous-celled carcinoma, keratinization and the formation of cell nests being marked features of the tumour (fig. 5).

The pelvic growth also invaded the kidney substance, and in many areas the microscopic appearance suggested that the cells of the collecting tubules were primarily involved in squamous carcinomatous changes, but this appearance is probably due to strands of carcinoma cells infiltrating and destroying the tissue among the tubules and giving rise to false lumina.

The cysts which have been referred to as containing the greenish gelatinous material present some features of histological interest.

The nature of the cells forming the cyst walls displayed no uniformity. In some areas they were of the nature of stratified squamous epithelium, with little or no tendency to keratinization, the superficial layer demonstrating swollen cells, spherical in shape and translucent in appearance (fig. 6). This hydropic change in other areas had replaced all evidence of the squamous nature of the cell (fig. 8). Intermingled with these clear round cells were considerable numbers of syncyteal masses of protoplasm containing numerous nuclei and an abundant supply of capillary vessels (fig. 9). These different areas were abruptly demarcated in parts of the cyst wall but the transition was gradual in other portions (fig. 7).

The cyst contents consisted mainly of cells in all stages of degeneration which had apparently been shed from the lining membrane.

These clear cells were found not only lining the cyst walls but also extending from the basal layers into the kidney substance, which they had infiltrated and destroyed (fig. 10). In some areas they were found among strands of squamous-celled carcinoma (fig. 11). The small residual amount of kidney substance was in a condition of fibrosis, probably due in part to pressure, and also to the pre-existing pyelonephrosis. Such tubules as remained intact were filled with pus cells and the usual small cysts lined by renal epithelium, as found in granular contracted kidneys, were present.

Discussion of the New Growth.

The changes which have been described in this new growth of the kidney well illustrate the capacity possessed by epithelium for undergoing metaplasia. Presumably the stratification which had taken place was protective in nature, and produced in response to the irritation caused by a pre-existing pyelitis. Such cases of epidermization have been usually described in association with calculi, but there was no evidence of calculus in the present case.

Squamous-celled carcinoma of the pelvis of the kidney was first described by Kundrat in 1891, and other cases have subsequently been recognized. Extensive hornification and cell nest formation appear to have been a prominent feature of these neoplasms.

The method of cyst formation in those cases in which the lining of

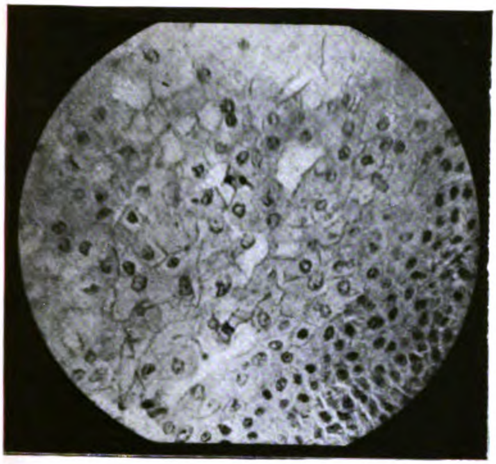


FIG. 6.

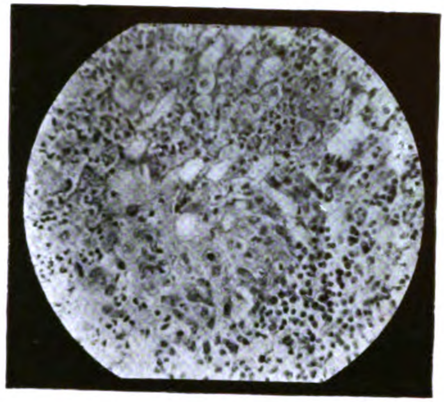


FIG. 7.

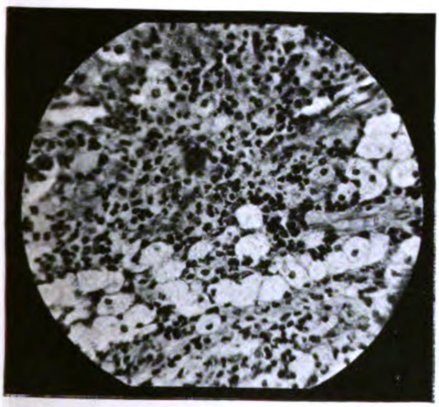


FIG. 8.

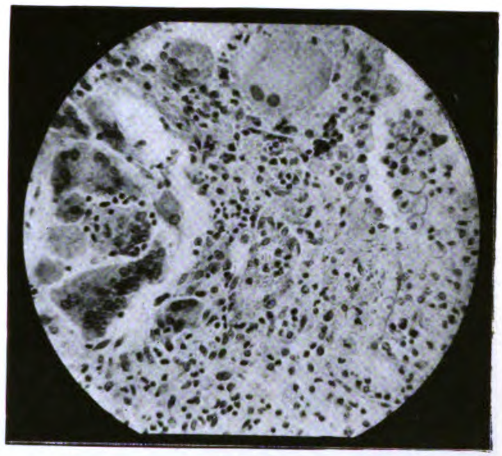


FIG. 9.

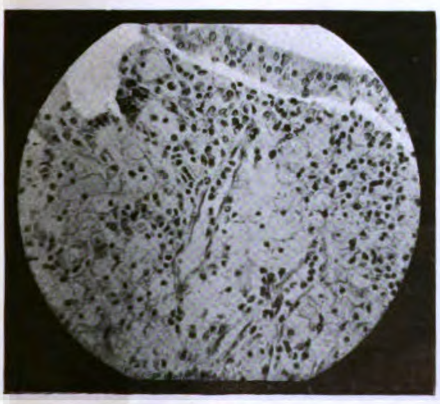


FIG. 10.

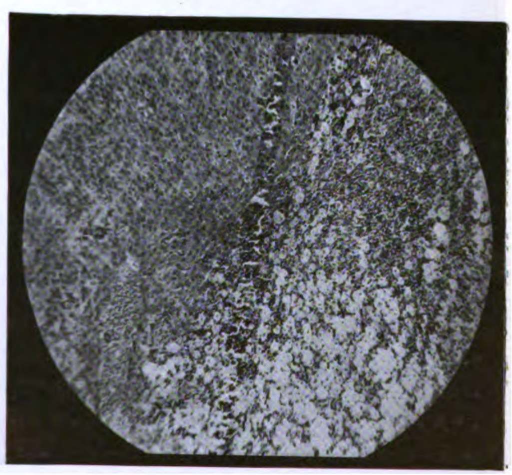


FIG. 11.

To illustrate "Epidermization of the Transitional Epithelium lining the Pelvis of the Kidney, followed by Squamous-celled Carcinoma, and other Changes," by Major J. A. MANIFOLD.

the cyst is entirely composed of stratified epithelium, is analogous to the method of formation of cell nests, the only difference being one of degree.

The epithelium lining the cyst is normal in appearance, with well-formed prickle cells and a definite basal layer. In portions of the larger cyst, however, carcinomatous extensions of cells are found infiltrating the surrounding tissues, the infiltration being by loosely arranged masses of cells, in appearance entirely different from the squamous-celled carcinoma arising from the pelvic epithelium. The impression derived from examination of the sections is that the original epithelium involved in the cyst formation was precancerous in nature, and that carcinomatous changes developed at a later stage.

Figs. 2 and 3 demonstrate the normal appearance of the epithelium, and fig. 4 the carcinomatous extension from the basal layers of the cyst lining. The formation of the second type of cyst, which has been described as being lined partially by stratified epithelium and partly by a clear type of cell, is more difficult to interpret. The first series of sections made from the walls of these cysts demonstrated only the clear cells lining the cyst, giant cells and ill-formed blood-vessels: an appearance almost identical with that encountered in the hypernephromata. Masses of these clear cells were also found invading the kidney substance. There is thus the possibility that these clear cells represented one of the constituents of a hypernephroma, but their presence appears to be capable of another interpretation. A similar type of clear cell is described as occurring in a growth of the kidney termed an "adenocarcinoma" with clear cells. Further, the possibility that these clear cells are foreign to the part, and are wandering cells which have phagocyted fatty matter resulting from degeneration, must be considered. This latter view was considered a possibility by Dr. Kettle, who very kindly examined some of the sections bearing on this point.

Certain appearances, however, have caused the opinion to be formed that the presence of these clear cells is not satisfactorily explained by any of the above possibilities. The fact that the stratified epithelium in various areas gradually assumes the clear-celled appearance, until completely replaced by this type of cell, is presumptive evidence that their origin is epithelial and is identical with that of the cells of the stratified areas.

Professor Wilson in his article on cancer of the uterus in Eden and Lockyer's "New System of Gynæcology," vol. ii, describes a similar condition. He considers the clear appearance of the cells to be due to mucoid degeneration, and to be accompanied by keratoid degeneration. Figs. 5 and 8 in the text are almost replicas of two of his plates (239, 283) which illustrate these conditions in cancer of the uterus. He, however, considers that the actual metaplasia of the columnar epithelium of the uterus into stratified squamous as a precursor of the carcinoma does not occur. In the tumour under discussion this stratification is obvious.

A further point against a pre-existing hypernephroma is the obvious

origin of the tumour in the medulla of the kidney. Giant cells are common in hypernephroma, but are equally common in other kidney conditions, their presence probably being caused by deposits of fatty acid crystals in the tissue, due to lipoidal degeneration.

In two areas incorporated in the capsule of the kidney were tissues resembling the medulla of the suprarenal (probably suprarenal rests). In both these areas large giant-celled systems were evident.

The appearance of the growth in adenocarcinoma with clear cells is described as being always papillary in nature, and originates from the parenchyma cells of the kidney. In this case the growth showed no papillary characters and the origin of the tumour cells is originally from epithelium lining the renal pelvis.

The outstanding pathological features of interest in the growth which has been described are the mutation from transitional to stratified epithelium which has taken place in the cells lining the pelvis of the kidney; the subsequent development of a squamous-celled carcinoma from these metamorphosed cells; the origin of cysts lined by stratified squamous epithelium throughout the kidney substance, from which malignant extension occurs; and finally infiltrating columns of a clear-celled type of epithelium arising from other cysts, in the walls of which these cells are found.

I am indebted to Lieutenant-Colonel H. Marrian Perry for many helpful suggestions.

DESCRIPTION OF FIGURES.

FIG. 1.—Slab section of kidney and tumour.

FIG. 2.—Small cyst entirely lined by stratified epithelium: contents keratin only. × 156.

FIG. 3.—Normal stratified squamous epithelium lining larger cyst. × 156.

FIG. 4.—Carcinoma cells invading kidney substance from basal layer of a portion of stratified squamous epithelium. (Photograph from same section of tissue as fig. 3.) × 156.

FIG. 5.—Areas of squamous-celled carcinoma showing formation of cell nests. × 156.

FIG. 6.—Keratinization absent in lining epithelium of cyst surface; surface cells clear and hydropic in appearance. × 246.

FIG. 7.—Stratified squamous epithelium represented by only a few cells of basal layers; cells becoming clear and rounded. × 246.

FIG. 8.—Clear cells lining cyst. (Microphotograph of next field from fig. 7.) × 246.

FIG. 9.—Wall of cyst lined by proliferating clear cells, showing also capillary vessels, and syncyteal masses of protoplasm. × 246.

FIG. 10.—Clear cells infiltrating kidney substance; portion of a large collecting duct of kidney seen at top of picture. × 246.

FIG. 11.—Squamous-celled carcinoma cells and clear cells intermingled, and invading kidney substance. × 156.

NOTES ON SANDFLY FEVER.

By Captain R. D. CAMERON, M.C.
Royal Army Medical Corps.

(1) Incubation Period.

The following table deals with a series of cases of sandfly fever contracted by troops forming the guard on Mejidieh Fort, Chanak.

This guard, consisting of one non-commissioned officer and three men, mounted daily at 18.00 hours from October, 1922, to August 3, 1923, and was furnished by different battalions of infantry and batteries of artillery.

The first case occurred in the guard of June 20 to 21, and the last in the guard of August 2 to 3, after which the guard was discontinued.

The total number of cases of sandfly fever contracted on this guard was thirty-eight.

These observations were made simply because it was possible to estimate the incubation period definitely *under natural conditions.* The guard was supplied by units who were in camp about a mile away.

If "A" be taken as the day on which the guard mounted at 18.00 hours, the following table shows the numbers who (*a*) felt ill, and (*b*) reported sick, and were admitted with sandfly fever on each successive day thereafter:—

	Numbers who felt ill	Numbers who reported sick and were admitted
"A" day	—	—
" + 1 day	—	—
" + 2 days	1	—
" + 3 "	8	—
" + 4 "	20	7
" + 5 "	6	22
" + 6 "	—	5
" + 7 "	3	2
" + 8 "	—	2
Total	38	38
Average	4·1	5·2

Conclusions.

(1) No case feels ill enough to report sick until the fourth day.

(2) The average day on which a man feels ill enough to report sick is the fifth day.

(3) The incubation period is never shorter than two days and never longer than seven.

(4) The average incubation period is four days.

The numbers involved are small, but the conclusions reached were generally supported by the experience of other guards in the area, where

the incubation period could be definitely traced. The results of the Mejidieh Fort guard alone have been summarized, because this guard provided the heaviest infection: during the period in question twenty-eight per cent of the troops forming this guard were infected, and in several instances three out of four men from one particular guard were admitted.

(2) Place of Infection.

The following table shows the place of infection in the 500 cases of sandfly fever admitted to the 83rd Field Ambulance, Chanak, during the period June 3 to August 26, 1923. The first case in 1923 occurred on June 3, and records were discontinued on August 26, by which date the troops had begun to evacuate Turkey.

During the period in question the great majority of the troops, roughly ninety per cent, were in camp—half to two miles away from any building.

The remainder were retained in the town of Chanak, either (1) in buildings or (2) in tents adjoining buildings, and separated from them by not more than 100 yards, about five per cent in each.

In addition, the troops in camp provided a small number of men daily for guard and picquet duty in the town, and these men during their tour of duty were accommodated in buildings or tents near by.

For the purpose of statistics it was therefore necessary to obtain an accurate record of movements during the previous ten days of all men admitted with sandfly fever, so as not to impute to camp infections those which might have occurred in town.

The cases shown in the "Camp" columns had not left camp at all for ten days prior to admission, and no doubtful case is included in the camp infections.

Infected in:	3/Hussars	R.A.	R.E.	R.C.O.S.	1/Buffs	1/K.O.S.B.	2/R. Sussex	2/H.L.I.	2/R. Bde.	R.A.S.C.	R.A.M.C.	R.A.V.C.	R.A.O.C.	Mil. Police	Total
Buildings	—	37	4	33	..	23	21	5	8	10	8	14	9	21	193
Tents near buildings ..	—	11	1	4	1	4	6	3	1	5	125	2	–	7	170
Camp	5	24	9	19	3	13	31	15	15	..	—	3	—	—	137
Total	5	72	14	56	4	40	58	23	24	15	133	19	9	28	500

From the above table it is not possible to estimate the relative percentage of cases occurring under the various headings, as the total number of troops in each case could not be accurately determined.

The table, however, bears out the well-known high infectivity of buildings, and further shows that: (*a*) tents within 100 yards of buildings are almost as infective as buildings themselves; and (*b*) men were infected with sandfly fever in open camp in some cases two miles away from any building.

(3) Relapses or Readmissions.

Of these 500 cases 71 were readmissions, i.e., 65 men had two attacks each and three men three attacks each. In other words, 429 men were involved in the 500 cases. The percentage of readmissions, therefore, works out as follows:—

Percentage who had second attacks	.. ..	15 per cent.
,, ,, ,, second and third attacks	..	7 ,,

Whether the cases were relapses or reinfections it is impossible to say. It was not found that there was any definite interval between attacks; this varied from three to sixty-two days.

A few cases gave a history of having had sandfly fever in previous years, but the majority of the 500 cases were fresh infections.

Records for two consecutive years were available in the case of twenty-one men of the Royal Army Medical Corps who were in Chanak in both summers (1922 and 1923). Of these, nine men who had an attack in the summer of 1922 had a further attack in the summer of 1923.

I am indebted to Major A. D. Fraser, D.S.O., M.C., R.A.M.C., O.C. 83rd Field Ambulance, who first suggested that the records be kept, and afterwards assisted in preparing them for publication, and to No. 7250317 Corporal Woods, A., R.A.M.C., who kept the statistics.

Clinical and other Notes.

A BRIEF DESCRIPTION OF A CASE OF MOLLUSCUM CONTAGIOSUM, WITH SPECIAL REFERENCE TO THE ISOLATION OF A CULTURABLE MICRO-ORGANISM FROM THE LESIONS.

By Captain R. N. PHEASE.

Royal Army Medical Corps.

The following observations were made on a case of molluscum contagiosum, with a view to ascertaining whether a culturable organism is associated with the lesion and its precise significance as regards the ætiology of the condition.

In January, 1923, Pte. A., of the 2nd Battalion Royal Ulster Rifles, presented himself at the medical inspection room, complaining of the occurrence of wart-like growths in the right axilla. The condition had begun some two months previously with the appearance of several small sessile papules, which slowly increased in size and became more numerous. The patient experienced no pain or inconvenience as a result of their growth, and their presence was discovered by accident.

Examination revealed the presence of some twelve to fourteen small discrete wart-like growths in the right axilla and neighbouring parts, for the most part congregated together, though a few were outlying. The distribution suggested that contact infection played an important part in the site of the origin of the various tumours. Individually, they varied from an eighth to a quarter of an inch in diameter, and presented an appearance resembling a mother-of-pearl shirt button, the smaller ones being sessile, the larger tending to become pedunculated.

They presented the appearance of a waxy-rounded prominence which rose abruptly from the surface of the surrounding skin rather than that of a wart. The top was flat, and did not present the papilliform appearance of a wart, while a small puckered central depression was visible in the larger variety. In consistence these prominences were firm and solid, and gave the impression of a kernel within the overlying skin. In colour they were a delicate shade of pink. Normally there was no appearance of any reaction in the surrounding tissues, though in one case the tumour had become the seat of inflammation and suppuration with the formation of a small pyogenic abscess. The tumour was freely movable, and showed no attachment to the deeper structures.

For the purposes of examination one of the growths was excised, embedded in paraffin, and sections were cut. The tumour was found to con-

sist of a cyst-like structure. The wall of the cyst was composed of a number of conical bodies with their bases directed towards the periphery and their apices pointing towards a central cavity, and separated from one another by fibrous septa continuous with the surrounding fibrous tissue of the corium. Except in the neighbourhood of the common central opening where the epithelial lining became continuous with the epidermis, the tumour, growing down from the basal layer of the rete mucosum, was situated in the corium.

The bodies were composed of a series of layers of cells which varied in character according to their depth from the periphery of the tumour.

The outer cells were columnar in shape, regular in arrangement, and resembled the cells of the palisade layer of the skin. Internal to these the cells assumed a cuboidal formation, and began to show signs of degeneration in that their nuclei were less distinct, and took up the stain less readily. Towards the centre of the tumour this process of degeneration had become more complete, with the result that the regular cell formation of the periphery had given place to a homogeneous matrix, in which was embedded the structureless remains of the cells which were gradually shed off into the interior of the tumour, and gave rise to the whitish pultaceous debris which formed the central portion of these tumours.

It is now accepted that the clear hyaline appearance surrounding the nucleus of the cells in this condition is due to imperfect cornification of the cells of the rete mucosum, and as a result masses of hyaline or colloid material are formed instead of keratin.

Although up to the present no specific infective agent has been discovered, the contagious nature of this condition has long been recognized. The frequency with which the condition occurs in epidemics, particularly in institutions for children, the authenticated cases of accidental inoculation, and, lastly, the experimental work of Retzius, Pautry, Haab, and Pick, clearly point to the presence of some infecting agent. The condition appears to be particularly prone to be spread by public baths—so much so that in Damascus it is known by an Arab designation meaning "the itch of the bath" (Norman Walker).

Various theories as to the nature of the infecting agent have been propounded, of which the following may be quoted:—

(1) *Neisser*, that the condition is due to a protozoon which he describes as occurring within the interior of the tumour and to which he gave the name molluscum bodies. These have since been shown to be varieties of degenerated cells shed into the interior from the inner wall of the tumour.

(2) *Juliusberg* considers the condition to be due to a filterable virus.

(3) *Lipschutz* described the presence of minute organisms in the degenerated epithelial cells of the tumour to which he gave the name *Strongyloplasma hominis.*

(4) The frequent association of the condition with pediculosis led Ehrmann to suggest that pediculi might be the intermediate host of the

parasite. If this were true we might have expected molluscum contagiosum to have been common in the late war, which was not the case.

With a view to ascertaining if any culturable organisms could be isolated from the lesions one of the tubercles was opened and cultures were made from the interior on agar and blood-smeared agar (Pfeiffer) and cultured aerobically and anaerobically after the method of Wright. After incubation at 37° C. for twenty-four hours no growth occurred in the tubes cultured under aerobic conditions, or on the plain agar cultured anaerobically. On the blood-smeared agar cultured under anaerobic conditions a scanty pellicle of growth was visible. The individual colonies were clear and dew-drop-like in appearance, and closely resembled those of streptococci, being heaped up in the centre and with a smooth rounded border. In size they were almost indistinguishable individually with the naked eye and required a hand lens for their identification.

In stained smears the organism proved to be a micrococcus about seven microns in diameter, staining readily with all the aniline dyes, and retaining the stain in Gram's method. It did not occur in chains but singly or in small groups.

Subcultures were made on blood agar, blood-smeared agar, plain agar bouillon, serum bouillon (human serum being used), and peptone water. Aerobic and anaerobic methods were again employed. After twenty-four hours at 37° C. growth was obtained only on the blood agar, blood-smeared agar, and serum bouillon when cultured anaerobically. The surface growth on blood agar and blood-smeared agar presented the same appearance as in the primary culture. Growth occurred in the serum bouillon with uniform turbidity and only slight sedimentation. Films prepared from this bouillon revealed a coccus growing singly or in small clusters, never in chains. After forty-eight hours' incubation minute signs of growth were visible on the plain agar anaerobic culture. By the end of seven days the colonies had enlarged to two to three millimetres in diameter, and were heaped up in the centre and shelved off towards the edges. Subsequent subcultures on plain agar grew more freely but blood agar was found to be the optimum medium for growth.

Similar experiments were repeated on subsequent occasions, different tumours being chosen in each case. Only those lesions which showed no signs of secondary infection were chosen. In all cases a pure culture was obtained on blood agar when grown under anaerobic conditions. The primary culture on plain agar refused to grow except when a considerable quantity of blood was transferred with the inoculum to the medium. Subcultures grew on plain agar at first with difficulty, later regularly. Further, in order to maintain a series of subcultures, it was found necessary to subculture every ten to fourteen days, otherwise the growth tended to die out.

In order to ascertain if organisms such as those obtained on culture were present in the tumour itself, and if so their precise situation, sections

of the tumour were stained by Gram's method. Such sections showed the presence of numerous Gram-positive organisms situated in the interior of the tumour and particularly arranged in the homogeneous matrix around the inner wall and adhering to the surface of, but never inside, the degenerated epithelial cells. The inference is that these organisms *in vivo* are not incorporated in any of the formed or degenerated elements of the tumour, or inside the degenerated cells as was described by Lipschutz, but are free in the cavity, and on section only those are preserved which have adhered to the homogeneous debris of the interior or to the surface of the degenerated and cast off epithelial cells.

Inoculation experiments were carried out on guinea-pigs, rabbits and monkeys. The cultures were inoculated cutaneously after scarification, intradermally and subcutaneously, but so far without success.

To summarize, the following points are of interest in connexion with the above case:—

(1) The demonstration of a Gram-positive micrococcus in stained sections of the tumour, which possibly corresponds to the micro-organism described by Lipschutz.

(2) The repeated isolation in pure culture of a Gram-positive micrococcus from separate lesions and at varying intervals.

(3) The fact that such cocci are obligatory anaerobes: a characteristic which one would expect to find in an organism growing within a closed cavity, such as the tumour, and deprived of blood supply and oxygen.

Unfortunately no other cases of molluscum contagiosum have been encountered, so it has not been possible to determine the constancy of the association of the organism with that condition. The case is recorded in the hope that other workers may confirm my observations.

In conclusion, I wish to express my gratitude to Colonel F. J. Brakenbridge, C.M.G., R.A.M.C., for his assistance in compiling this report; and to Major W. R. O'Farrell, R.A.M.C., for his many useful suggestions and his help in preparing the sections.

[*Note.*—A culture of the organism isolated from the above case was submitted to Lieutenant-Colonel Perry, Professor of Pathology, R.A.M. College, who inoculated a series of rabbits by scarification and by the intracutaneous and subcutaneous methods without any obvious pathological lesion resulting in the inoculated animals. In the absence of this important experimental proof of the specific pathogenicity of the microbe, it is considered that its pathological significance is doubtful.—EDITOR.]

REFERENCES.

HEKLOEN and RIESAAN. "Text-Book of Pathology."
HARTZELL. "Diseases of the Skin."
NORMAN WALKER. "Introduction to Dermatology."

———

CASE OF PELVIC TUMOUR OF OBSCURE ORIGIN.

By Captain F. STUART TAMPLIN.
Royal Army Medical Corps.

The patient, Lance-Cpl. N., reported sick at the Military Hospital, Chester, on January 3, 1923, with abdominal pain, not severe, and a "swelling."

History.—On Christmas Day, 1922, the patient complained of "pain right across the stomach" of a few hours' duration only. On December 31, 1922, he had another similar attack of pain and he noticed a swelling in the "lower part of his abdomen." This pain has persisted until the present time (January 3, 1923). Bowels not opened since January 1, regular until then. No vomiting or nausea; no malaise. Temperature 99; pulse 80; tongue furred.

On examination: The patient did not look ill, and he walked without difficulty. A very definite tumour could be felt arising (apparently) out of the pelvis, with its apex towards the symphysis and its base about one and a half inches above the umbilicus. This tumour was somewhat tender on pressure, dull on percussion and non-fluctuant. Not adherent to the skin. No heat or redness over it. There was no difficulty in passing urine. Catheter passed freely and emptied the bladder. Enema of soap and water gave a copious result of normal fæces without having any effect on the tumour (January 3, 1923). On January 4, 1923: Enemata were given in morning and evening with good results, but the tumour remained unaltered, though its upper border was very slightly lower. Temperature, pulse, etc., normal. No family history bearing on the case. Patient was transferred to Military Hospital, York, for observation, and, if necessary, that a laparotomy might be done.

Notes by Captain J. W. Archibald, R.A.M.C. (T.), from Military Hospital, York, in continuation of above.

Operation on January 9, 1923.—Abdomen opened, large cystic tumour delivered out of pelvis, lying beside it was a calcareous gland about the size of a hen's egg. The cyst was lying between the layers of the mesentery and could be fairly easily shelled out, the calcareous gland was also removed. Cavity stitched up and drainage tube inserted; abdomen closed.

February 1, 1923.—Patient progressed favourably, stitches removed, wound healed except for small tube sinus.

February 22, 1923.—Discharged, convalescent, and recommended twenty-eight days sick leave.

PATHOLOGIST'S REPORT.

Report on Material from Cpl. N.

The gland was enlarged, broken down and full of caseous matter, tubercle bacilli in fair numbers were demonstrated in the contents.

The wall of the cyst was fibrous and surrounded by granulation tissue. The cyst contents were mainly fat, together with some calcium salts.

The cystic swelling evidently followed chronic fibrosis and occlusion of a lymphatic vessel, due to tubercular infection, the process resulting in a chylous cyst.

January 18, 1923. (Signed) H. M. J. PERRY,
Lieutenant-Colonel,
Professor of Pathology,
Royal Army Medical College.

On June 19, 1923, patient, having had furlough, and subsequently done only light work, reported sick with abdominal pain of increasing severity and incessant vomiting. He had resumed full work on Thursday, June 14, and without any assistance changed heavy tyres on a car. After a long day's work to-day (19th) he was unable to carry on with his duty any longer.

On admission to Military Hospital, Chester, tender lumps were found at edge of right rectus, above the level of the umbilicus, the rest of the abdomen being flaccid. Temperature normal; pulse 64; tongue furred. Simple enema given at 9 p.m., poor result. Severe vomiting at 9.30 p.m. Transferred to Royal Infirmary, Chester.

NOTES SUPPLIED BY HOUSE SURGEON, ROYAL INFIRMARY, CHESTER.

June 19.—Lance-Cpl. N. admitted with severe vomiting and abdominal pain. This cleared up after a good result from a turpentine enema. Nothing of note found on abdominal palpation.

June 21.—Discharged, with abdominal belt.

June 22.—Readmitted in the evening in a state of collapse, with rigid abdomen and vomiting.

Operation.—On opening the abdomen the wall of the original (mesenteric) cyst was found adherent to the peritoneum at the site of original operation scar, and also to intestine and mesentery. Adhesions were divided. Incision sewn up. No tube was inserted. After operation patient suffered from abdominal distension, flatulence, intractable constipation and dyspnœa.

July 1.—Laparotomy. The terminal portion of the ileum was bound down by dense adhesions, about two feet of it being gangrenous. The gut was much distended above, and collapsed below. The gangrenous portion was resected, and a lateral anastomosis done, an artificial anus being made at the lower end of the incision in abdominal wall. A marked improvement in general condition followed until July 7, patient having progressed from sterile water only to milk diet, with custard, etc.

On July 8 he began to show signs of septic absorption. From now on he gradually sank, and died on the morning of July 12. Towards the end he had been on pituitrin, strychnine, digitalin and morphia as necessary. The superficial operation wound had sloughed, the peritoneum remaining intact. Death was due to heart failure from septic absorption following on the removal of the gangrenous gut.

YARNS OF A SHIP'S SURGEON. THE "WASP" AGAIN.

By Lieutenant-Colonel C. R. L. RONAYNE.
Royal Army Medical Corps (Retired Pay).

As it is not always possible to appreciate one's own writing or composition, I thought I would ascertain a friend's opinion on my diary of "Around the World" which appeared in the Journal some time back. So I gave him an excerpt to read, and after he had read it I asked him what he thought of it. He replied: "You relate a very interesting incident about the Christian Scientists." And he added with a gleam in his eye: "Did you follow up the case?—such cases should always be followed up."

For those who have not read the diary perhaps I may repeat the part to which he referred. It reads: "To-day we heard of an interesting case that occurred recently in the district. The child of wealthy parents was badly afflicted with bandy or bow legs. The best surgeons and physicians having failed to effect a cure, it was decided to give the Christian Scientists a trial. They undertook to try; and so, three of the leading exponents, together with the child, were closeted in a room. For three hours the Christian Scientists exercised the most intense mental concentration, without a moment's relaxation. At the end of this time the blinds were pulled up, and the child examined—he was found to be suffering from knock-knee. Apparently the concentration had been overdone."

On the whole I was much disappointed with my friend's remarks, as nothing else in the diary appeared to have interested him—and indeed he seemed so absorbed over the psycho business, I was somewhat nonplussed, and had not the courage to ask him more.

But I had a different experience in connexion with the account of "Yachting at Gibraltar" which I wrote and which appeared in the Journal of May, 1914. I was surprised at the interest this little article evoked. Officers wrote to me, even officers I had not the pleasure of knowing. One old retired Colonel gave a most interesting account of the sport at Gibraltar in by-gone days. Another officer wrote asking advice about a boat he had, and which he thought of "converting" as I had done.

Another communication was in the form of a post card (bearing the London post-mark). It read: "Yachting article good, but just a line to inform you, you are wrong in attributing your quotation to Byron." I was rather amused at this; and though not quite prepared to swear to it, I am almost sure my anonymous communicant is wrong, and the lines I quoted are from "The Traveller," by Byron. They begin:—

> The patriot boasts, where'er he roam,
> His first, best country ever is at home;
> And yet perhaps, if countries we compare,
> And estimate the blessings which they share, etc.

Perhaps then it may be interesting if I bring the history of the yacht I had at Gibraltar up to date—the "Wasp."

Recently when loading cargo at Yokohama, I noticed some bales of silk lying on the wharf with "Gibraltar" marked on them, and on making inquiries I found we were going to call at Gibraltar on the way home. This was welcome news for me, as I had not been there for eight years, and I was anxious to look the place up again, and, if possible, find out what had become of the "Wasp." In due course we arrived at Gibraltar—but I must here make a digression in order to bring the history of the "Wasp" up to date, as far as I am concerned.

Shortly after the war broke out in 1914 I got orders to leave Gibraltar.

The "Wasp" was then in excellent condition, and fully found in every respect, including a set of almost new racing sails by Lapthorn, and a fine set of cruising sails, very kindly given me by Captain W. G. Wright (now Major, D.S.O.) of the Corps. She had also moorings, and a sturdy punt. I valued her, all told, at about £90. But owing to the then uncertain outlook, I knew there was little prospect of getting this amount; so I put an advertisement in the *Gibraltar Chronicle* offering her for £40. To this advertisement I did not get a single reply; I then got permission to tie her to the Flag Ship "Cormorant," and a petty-officer on board undertook to look after her. In a few days I left Gibraltar.

On the troopship going home, some of the young officers almost mutinied —their grievance was that our ship stopped whilst our naval escort was busy sinking an Austrian merchant ship. They thought we ought to push on at all cost, as even a few hours might make a big difference, and the chance of active service be lost owing to the Germans throwing up the sponge. By the way, on this occasion, one of the minor "lessons of the war" was learnt—that is, if the sea is quite calm, it is practically impossible to sink by gun-fire a cargo ship light in ballast. At least our escort found it so.

Very few people seem to keep a diary. Some say it is too much "fag" to keep; others say it is tell-tale—perhaps occasionally it may be so. I have kept one now for a good many years, and from time to time I find it very useful to look up a name, or the date of an event, etc.

When I commenced to write about this "minor lesson of the war," I wanted the names of the ships concerned and the date of the incident; but I suddenly remembered I had lost my diary. This was rather a severe blow, indeed so much so that I could not possibly have given these particulars were it not that a friend, to whom I had at the time written a long letter, had fortunately kept it, and came to my assistance. But whilst awaiting this information, perhaps I might mention it was somewhat misleading to say I "lost" my diary. I did not lose it in the ordinary sense of the word. One frosty night as I lay asleep in my bell-tent in France, I fancied I heard a noise. You know the confused way you get when disturbed at night; half conscious, half unconscious, with the result that by the time you are fully awake you cannot be quite sure whether you were

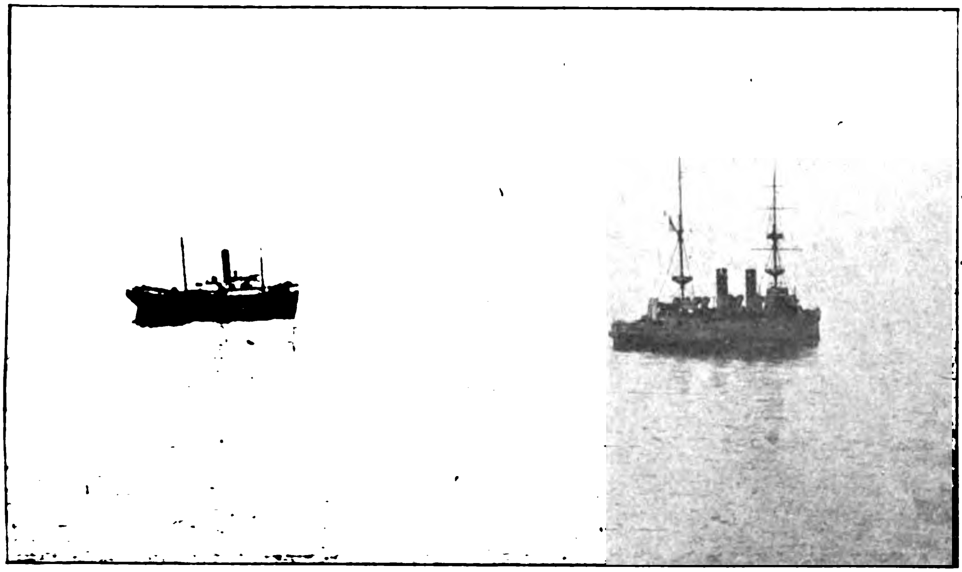
really disturbed, or merely dreaming. That was how I felt. But next morning I noticed the fly of the tent was unroped, though I had closed it as usual from the inside before going to bed. My suspicions were immediately aroused and on looking around I saw my suit-case was gone. I called my servant and the hue and cry was raised, but without result.

Some time afterwards the suit-case was found on a piece of waste ground ruthlessly cut open with a knife, and everything gone. I thought it particularly mean taking the diary, as it could be of no use to anybody. One or two little incidents subsequently occurred which clearly showed me one of the Mess-servants was the culprit, but evidence sufficient for a conviction could not be got. However, he was sent back to his depot; and curiously enough, he shortly afterwards got a heavy sentence for stealing from a comrade.

I had asked my friend merely for the name of the cruiser and the Austrian ship and the date of the incident; but he sent me the whole letter, so perhaps I might give an extract from it. The letter is headed, "Union Castle Line, R.M.S. 'Edinburgh Castle,' off the coast of Spain, September 1, 1914," and reads: "We have had such uncertainty about the date of starting. On August 15 I got orders to sail on 20th—but later on that day the order was cancelled. Then I had orders for 'about the end of August.' On the 28th we were told we would not go until September 15 and next day we were told we would go next day, i.e., 30th. By wireless they stopped this steamer on its way home from South Africa. She arrived in Gibraltar on last Sunday and all that day there was a crowd of workmen on board fitting her up suitable for troops. She is a very fine ship of 13,326 tons, quite new and beautifully fitted. I had all my things on board by 1 o'clock except a few hat boxes and other light articles, and after lunch on board I went back to my quarters for these, but when I returned, to my surprise, I found the ship had left for the 'detached-mole.' However a naval pinnace soon had me on board. We were told we would be moored to the 'Mole' for four days—but, much to our surprise, we pushed off next morning at 7 a.m. Even the O.C. of the Regiment was not 'in the know' about the starting; of course all this trickery was to guard against any possibility of information getting to the German cruisers, which were known to be knocking about in the Atlantic. We were accompanied by torpedo-boats part of the way, and then a battleship met us off Cape St. Vincent. She has now left and a cruiser has taken her place.

"Last night I had the novel experience of sailing in a ship with all lights out. Of course in the saloon, etc., lights were on. But the port-holes were all curtained, and long strips of canvas and matting were used where necessary. No mast-head, port, or starboard lights were carried—still we did not seem to bump into anything. There are about forty first-class civilian passengers on board, and also a fair number of second class. They consist of English, French and Belgian—any other nationalities had

been refused. There are about forty French and Belgian Reservists returning. The ship was making her usual passenger trip from South Africa home when she was commandeered by wireless from Gibraltar. (I stopped writing at lunch time, and am now [8·30], after dinner, continuing.) After lunch, H.M.S. Cruiser 'Albion' came close and signalled, 'If pursued make a wide sweep to clear the enemy.' She then told us to follow half a mile behind, in her wake, as there were two ships in sight she did not know. Of course this caused great excitement on board, but after watching for some time, all interest died away as there was nothing to be seen. At 5 o'clock a 'tramp' very high out of water passed across our bow about two miles ahead of us. I happened to be looking over the



The cruiser (H.M.S. "Albion") about to open fire on the Austrian ship, "Bathori," September 1, 1914.
Probably a unique photo of the first enemy ship sunk during the war—almost certainly of the first Austrian, as war with Austria had been declared only recently. Unfortunately the light was too bad to take other snaps.

rail and I thought it curious a ship in her condition (so light) should be heading as she was straight from America. Suddenly the cruiser turned towards the 'tramp'; immediately the tramp stopped her engines (this could be plainly seen, as she was so light in the water her propeller was throwing a cloud of spray). After a few minutes she began to go ahead again, whereupon the cruiser put a shot across her bow. She stopped immediately and reversed her engines.

"I was one of the few who saw these preliminary incidents, but the shot, of course, brought everybody to the side, and the excitement was tremendous. A boat boarded her, and then another; we were standing by

quite close. Quickly the crew and all their personal belongings were bundled into the boats and brought to us. As the boats approached the soldiers cheered loudly, and to my surprise, the prisoners were looking up and laughing, and even the captain and some others waved their caps. She was the 'Bathori' of Fiume. But now a splendid and awe-inspiring sight began. Flash, bang, from the cruiser, and instantly a cloud of smoke and flame burst from the 'tramp' and she quivered with a life-like shudder from stem to stern. However, the effect was very transient, and quickly she was apparently none the worse.

"The second shot had just the same effect, but this time it was followed by a terrible and magnificent explosion, debris being thrown to a great height, with clouds of steam and smoke. Her bottom must have been blown clean out, and we expected she would sink like a stone. But there was no such result. Except for hissing of steam and some smoke, she seemed to recover and showed no signs of settling down.

"Shells now banged and zizzed at her and the grim tragedy went on, and she was soon burning furiously; still she stood at bay, she had not budged; she trembled and shook, but she had not settled down a single inch. We were so close to her it was easy to see this with glasses. I wonder why? What were the shells doing inside? I should have thought 6-inch shells would go through and through the thin plates of a merchant ship. Some of course may have been deflected upwards when they struck —but surely not all; and all were of course fired in a slightly downward direction, so one would expect them to emerge below the water-line at the opposite side.

"A gunner officer tried to explain to me why the gunfire did not sink her—but I was not altogether convinced by his explanation. Anyway, a party had eventually to board her and blow her up; she then rapidly settled down. The charge had to be put right in the bow, as it was the only place where she could be boarded owing to the flames. The explosion was terrific; still she showed no ghastly wound, let alone being rent in twain, as well she should have been.

"The end, I think, must have been a good deal like the 'Titanic' disaster; she first heeled over to port, then her bow went down, and finally her stern and screw stood perpendicular out of the water, and as they disappeared there was a great explosion (evidently due to imprisoned air) and the water was lashed into great commotion."

The foregoing, though fairly lengthy, is only an extract from the letter, there are yet several pages. I think it may be described as *some* letter.

Before I left "Gib" a very thorough search of ships was being made for Germans. Not only was every ship which entered the harbour searched from truck to keel, but even ships passing through the Straits were brought into the harbour and searched, with the result that in a short time over 500 prisoners were under lock and key.

Of all these there was scarcely one who had not been trying to get to

Germany under one disguise or another. Some, posing as allies or neutrals, were indignant when it was proposed to search their baggage; others were dug out hidden away in most inaccessible parts of ships.

But probably the great majority were trying to get through by posing as deck-hands, or working in the engine rooms. Needless to say the bag was a very mixed one; it included the German tennis players who were in America when war broke out, representing Germany in the Davis Cup tennis contests. It also included one Major von Ritter; the major was regarded as an important capture as he was on the German General Staff, and had been in South America buying up horses and arranging other little trifles.

He was taken out of a stokehole covered with grime and soot, where he had been innocently working his passage home. As soon as he had washed off the soot he "assumed command" in the internment camp on the Rock, and was the cause of much trouble to the authorities, organizing complaints, demanding privileges, etc.; so the first opportunity to ship him to England was taken, and he was put on board our ship.

Even allowing for the destruction to which men became accustomed in the course of the war, I think the sight of a powerful cruiser pouring shells into a ship at short range would never be classed as an everyday sight; it certainly was not in those early days of the war; and so, when the bombardment began, every possible vantage point on our ship was crowded with troops in tense excitement to see the grim sight; in the ship's boats, the rigging, everywhere were men. Officers were packed on the fore part of the hurricane deck, and behind them was standing Major von Ritter, his great height enabling him to see easily over the heads of those in front.

Shortly after the bombardment had begun he said in a loud voice, evidently intended for those around to hear: "Oh, shame! Do you call that war?"

Considering how strong passions were running at the time, it was a very risky remark to make, but one needed only to glance at his mail-fisted face to appreciate the word "fear" had no meaning for him. Anyway he spoke with firmness, loudness, and a sardonic snarl. But except for a few scowls by junior officers no notice was taken.

(I may here mention the first intention was that the captured ship should accompany us to England, and it was only decided to sink her when it was found she had not sufficient coal in her bunkers to steam the journey. She had been supplying the German warships at sea with coal.)

Major von Ritter was allowed to move about the ship freely, except that there was a sentry always close by his side; this was a source of much irritation to him, and he tried to get such close supervision discontinued, but unsuccessfully.

I had one or two conversations with him, but he was difficult to converse with, as he seemed to have war on the brain. He told me he had never

played any game in his life, he had no time, as even from his earliest youth almost all his time was taken up with military training.

On one occasion I asked him which side would win the war. He replied: "Ah, it is impossible to say now." Two things in his reply struck me, one was the alacrity with which he made it, and the other the way he laid stress on the word "now." He evidently had some special consideration in his mind, and I was about to ask him what he meant when unfortunately I was called away, and I think I did not speak to him again until, curiously enough, I met him some years afterwards when I was E.M.O. at Havre.

He was then one of a large batch of prisoners on their way from England to Switzerland for internment there under the agreement. I met him on the quay as they disembarked and entrained. He told me he had recently been promoted Lieutenant-Colonel. He said that during the first couple of months in England he had been very badly treated, but after that he was well treated, and had no cause for complaint. I suppose the truth was that he tried to make things hum in the internment camp in England as he had done at Gibraltar.

At Havre he looked well and fit, and resplendent in his full uniform, at least to me it appeared to be "full," as did that of the other officers. Nearly all wore smart showy uniforms, with nothing of the "service dress" appearance about them. Several wore the ribbon of the Iron Cross. Some were minus an arm or leg, but there were only three stretcher cases.

The crew of the Austrian merchantman were a motley crowd as they came on board our ship. But they were all smiles, and evidently in good spirits, which seemed strange as we were about to sink their ship. We found out afterwards their elation was due to their being taken off the ship, as they were certain they were about to be sent to the bottom with her. Not only were they rescued, but they were given time to collect their personal effects, and they did not forget to bring the cat and two canaries.

One of the crew was the most puny hunchback I have ever seen. What use the poor fellow could be on a ship, I cannot understand. Some one said he was the pantry boy. It's a curious thing, but these sort of people have often the largest amount of luggage—however, he was the exception proving the rule, as the only luggage he brought on board was a large umbrella. Old "sea-dogs" never go to sea without an umbrella—it keeps the wet from the oilskins.

Going ashore from the trooper I was depressed and pessimistic over the war outlook; however, a course of the home newspapers soon bucked me up with their hopeful and cheery confidence.

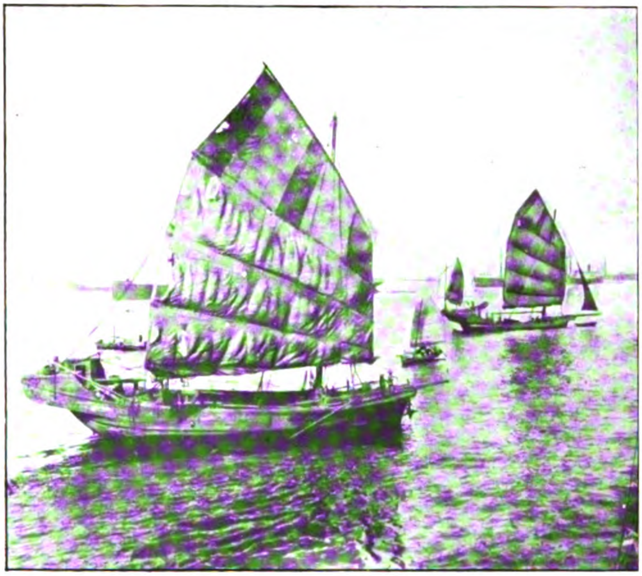
But the pessimism set in again about six months afterwards. One could not help feeling pessimistic at the way the opposing forces were dug in; so I consulted a "dug-out," and he said, yes, the war would last a long time.

I then wrote to the hon. secretary, the Gibraltar Yacht Club, and

Storm at Sea.

"Tranquillity."

To illustrate "Yarns of a Ship's Surgeon. The *Wasp* again,"
by Lieut.-Col. C. R. L. Ronayne, R.A.M.C. (R).



Chinese Junks in Hong-Kong harbour.

The Inland Sea of Japan. Scenery of endless variety and charming effect.

To illustrate "Yarns of a Ship's Surgeon. The *Wasp* again," by Lieut.-Col. C. R. L. RONAYNE, R.A.M.C. (R).

asked him to get £20 for the "Wasp." He wrote back and said, if I would accept half this sum, he still could not get it for her, as the harbour, as far as yachting was concerned, was completely closed down, and nobody was allowed on the water, except by special permit, and then only if accompanied by a constable at 5s. an hour. In short there "was nothing doing"; or, as the French would euphemistically express it "na poo."

So time went by, and I had almost forgotten the "Wasp," when one fine morning I got a letter from the hon. secretary to say a possible buyer was looking at her, and would I be willing to accept any offer he might make.

If this meant anything, it meant a proposal to sell her for a £10 note—or less. But the times and everything considered, I thought I had no alternative but to agree; and so, in due course I got a cheque for £8.

That was the end of the "Wasp" as far as I am concerned. £8! and at the time lead in England was selling at £44 a ton; and she had just a ton of it on her keel!

But I must now get on with her subsequent history and bring it up to date. As I said on the opening page, on our return from Japan, in due course we came to anchor at Gibraltar.

However, before I complete her history, perhaps I may be allowed a slight digression here in order to mention the extraordinary good luck we had out East.

We sailed the Eastern seas, that is, those of China and Japan, during August and September—months noted for typhoons. But day after day we went through a sea of glass, whilst never more than an occasional zephyr stirred the soft stillness of the tropical air around. Yet it is scarcely an exaggeration to say, wherever we went, we had a typhoon sweeping destruction, either immediately before or just behind us.

When we were off Hong-Kong on the outward journey, only a short day's run ahead of us, Swatow was being wiped out. The casualties of that typhoon will never be known. Some estimates put them as high as 100,000. The fine British India Company's ship "Gondia" disappeared in it with all hands—never a trace was found.

We were due to leave Shanghai in the early morning of Saturday, August 19, and as luck would have it, that morning the storm signals were hoisted for an approaching typhoon.

The one redeeming feature about typhoons—if the word "redeeming" may be applied to them!—is, that their course can be told with fair accuracy as they sweep along—a good deal more so than the course of "home" storms. And so, it was calculated on the "Novara" that if we got out quickly we would just miss the typhoon.

As we steamed down the river we saw crowds of junks and sampans making their way up the numerous small creeks; in some of these creeks craft were already crowded solid. This is the usual "cover" the floating population takes when storm warnings are hoisted. And these primitive people look out for and can read the warnings as well as any mariner.

Down the river we had a large German cargo ship following close in our wake. Near the mouth were several steamers anchored and made snug, awaiting the worst. The German ship now manœuvred into position with the other ships, and was about to let go her anchors, but she evidently noticed we were not going to do so, and after some hesitation she changed her mind, turned round, and again followed in our wake; but as we travelled faster we gradually dropped her.

Though the actual typhoon comes on with great suddenness, often a "preliminary canter," so to speak, ushers it in; and this was just what we experienced when we left the river and put to sea. The glass was at 29·30, and dirty black ragged clouds with mist were scudding across the sky, with half a gale blowing from the S.S.E. The gale continued and even increased for an hour or two; but before we turned in for the night there were welcome signs of an improvement.

Next day was an ideal day. But *en passant* I would remark the typhoon did much damage in and around Shanghai.

The reference to the native boats scudding up the creeks reminds me how interested I was to watch native life on these craft. I have seen nothing anywhere like that at Hong-Kong and Shanghai. On the Hugli at Calcutta one sees great crowds of craft, on the larger of which families live—but only men live on the smaller ones. Whereas at Hong Kong and Shanghai on every small sampan or boat (and there are many thousands of these measuring about six feet beam by twenty-three feet over all) lives a family consisting of parents and four or five small children.

Some of the larger junks look almost like nurseries, such crowds of children appear scampering about on them. Though these junks are only about the size of our deep-sea fishing trawlers, four or five, or more, families live on each. It is said the men live in perfect harmony; I only hope it is true of the women too—the space is very confined.

In the Far East life is so crowded nobody takes notice of anybody else; and so, from the quays, or merely by looking over the side of the ship, one can watch life undisturbed in these floating homes. Looking down one day this is what I saw: The sampan or boat was one of the small kind, that is, six feet beam by about twenty-three feet over all. She was solidly built, and in good condition; varnished, not painted. This summary gives a fair description of most of the boats of her size, and one is struck by the comparative cleanliness and smartness of the craft, which is all the more creditable as they truly represent "multum in parvo."

Near the bow of the boat was seated an infant, it looked about 1½ to 2 years old. It was tending a pot boiling over a brazier, and every now and then dropped bits of charcoal on the brazier. As it was not yet big enough to walk—at all events on the wobbly boat, its job was evidently to sit tight and tend the pot; whilst a child about a year older, which had already got its "sea-legs," was doing waitress on her brother and sister, who appeared to be about 10 or 11 years old, and were having breakfast

under the canopy aft. A couple of times this child emerged from under the canopy with a bowl in its hand; going up to the brazier it took up a ladle and put some of the contents of the pot into the bowl and returned to the dining saloon. The children inside appeared to be having quite a square meal. Right in the bow of the boat was lying a youth, with a fishing line in his hand, and he was evidently supposed to be "feeling for a bite." But he was fast asleep.

In the centre of the boat was a large hencoop packed with chickens (every boat has got one). The wife near by was rummaging her hands through a pot of boiled rice, and every now and again picked out (apparently) a piece of dirt, and threw it amongst the chickens. The chickens were no strangers to this performance, as could be seen from the way they were standing on tip-toe, ready to receive the delicacies.

In the stern of the boat was the husband holding a rope which went straight down into the sea; suddenly he started to pull it for dear life, and continued to do so until a basket came to the surface. Across the top of the basket were stretched some pieces of twine to which were attached pieces of bait. Apparently the idea was, that fish came to the bait, and then being over the basket when it was suddenly pulled on, they got sucked and pressed into the bottom; that the scheme was successful was shown by the fact that he took out three or four small fish from the bottom of the basket, which he immediately transferred to another basket close by, and hanging just submerged in the sea. In this way a continuous supply of fresh fish was ensured.

The foregoing is a little picture of life, typical on many thousands of these small floating homes. I merely record what I saw, while you wait, so to speak; but in watching many points occur to one. How for instance they sleep is inconceivable, as I could never detect a clear space sufficient for even one person to stretch on. Poles, ropes, oars, bits of loose planks, household utensils, all lying about in profuse and tangled confusion. In vain one tries to discover what they do when it rains—true, there is a canopy situated aft of amidships; but it is open at both ends. And at most is no more than five feet long. Apparently there is no cabin. Considering the size of the boats, the space occupied by the hencoop is very large, and it is usually cramfull of chicks.

The Chinese seem to live on and for chickens; it is said that with the exception of the bill, toe-nails, and feathers, there is not a stitch of chicken they do not eat—and I can well believe this judging by the awful concoctions one sees on the street stalls. Doubtless appetizing morsels to them!

What they do with their children over 10 or 12 years I do not know, as one never sees a child over this age on board.

Neither do I know how they earn money to pay for the rice, chickens, etc. A little is picked up by ferrying people to ships, or across the harbour, but there can hardly be enough in this traffic to support the crowds. The larger boats and junks, of course, carry cargo.

Altogether the life of these people is interesting and fascinating to watch, but it is around one in such profusion, few—I mean Europeans—seem to take any notice.

It is said sailors take off their hats to junks, such wonderful sea-boats they are. Personally, I intend to do nothing of the sort; for with all due respect to sailors, I feel pretty sure they are anything but *sea-boats*. I don't say they cannot stand any sea, but what I say is, compare a junk of say sixty tons with a "home" ketch or fishing boat of the same size—I say the crazy, rickety junk would lee-away, flounder, and founder in a breeze and sea in which the ketch would revel. No, but I don't mind taking off my hat to the men, women and children, who put to sea in such crazy craft—only too often they pay the price, poor people!

(*To be continued.*)

Current Literature.

(*Continued from p.* 318.)

Syphilis.—Van den Heuvel has compared the *results of different methods of treatment* in syphilis. Of 577 cases, 184 were treated by mercury only, 190 by mercury followed by neosalvarsan, 203 by mercury and neosalvarsan administered conjointly. As regards the effect on the Wassermann reaction, there was no great difference between the three methods; 52 per cent of cases became negative after the first method, 60 per cent after the second, and 63·5 per cent after the third. Tertiary or parasyphilitic affections developed in 4 per cent after the first method, 5 per cent after the second, and 0·5 per cent after the third; but in the last group two cases of iritis and three of choroido-retinitis developed during treatment. The author concludes that although the modern treatment of syphilis by mercury and neosalvarsan gives better results than treatment by mercury alone the difference is not so great as is generally believed, and the present treatment is far from satisfactory.

Pontoppidan insists that, though the injection of *calomel* is apt to provoke pain and severe mercurial poisoning, this method of giving mercury is of such high therapeutic value that every effort should be made to minimize these two drawbacks. As for the pain, it can largely be avoided by the administration of a twenty per cent calomel emulsion, as in this strength only 0·25 cubic centimetre of the emulsion need be injected. But it is difficult to be as accurate in dosage when such a small quantity as 0·25 cubic centimetre is injected instead of the 0·5 cubic centremetre of the formerly much-used ten per cent emulsion. By the use of the finely pulverized calomel *vapore paratum,* the pain of an injection can also be reduced. There remains the serious objection to the twenty per cent emulsion that it does not hold all the calomel in suspension. So, however conscientiously

and vigorously the bottle containing the emulsion is shaken before use, its concentration is liable to rise steadily as the contents of the bottle dwindle, and in the end 20 to 30 centigrammes of calomel may well be given instead of the desired 5 centigrammes. To avoid this risk, Pontoppidan suspends 5 centigrammes of calomel in pills or short rods of cocoa butter, each weighing 15 centigrammes. Dropped into a 1 cubic centimetre Record syringe, one such pill is gently heated till it melts, and it is then injected into the tissues, the complete emptying of the needle being effected by the forcing of a small bubble of air through it at the completion of an injection.

Having experienced two fatalities from calomel injections, Backer has abandoned this method of giving mercury as being too dangerous. He has collected sixteen cases from the literature, and he notes that, though in most of these cases the dosage was heroic, there were some in which it was moderate as judged by modern standards.. In neither of his own cases was the dosage excessive : the first patient, a man of 48, was given 10 centigrammes on three occasions at intervals of eleven to twelve days. The second patient, a woman aged 48, was given 5 centigrammes on three occasions at intervals of a week. Both patients were also given neosalvarsan, but the symptoms and post-mortem findings were unmistakably those of mercurial poisoning. In both cases the first two injections had been well tolerated, and there was practically no warning apart from slight tenderness of the teeth in the first case and slight gingivitis in the second.

Conrad and McCann have tried the effect of *intravenous injections of mercuric chloride* in cases of Wassermann-fast syphilis. In sixty-two out of 1,679 cases which remained positive after one to thirteen courses of arsphenamine intravenously and mercury perchloride intramuscularly, forty became negative after intravenous injection of the perchloride. The injections were given twice a week, beginning with 0·6 cubic centimetre of a one per cent solution in normal saline, increasing by 0·1 cubic centimetre at each injection up to 2 cubic centimetres, twenty injections being given for the course. Blood was withdrawn into the syringe containing the solution before injection to allow of mixing with the perchloride and injecting in the form of albuminate of mercury. The mimimum number of injections was six, the maximum twenty-two.

Cole, Gericke, and Sollmann recommend a modified form of *mercurial inunction* which is free from the dirt of the old method, and, incidentally, shows that the mercury is absorbed by the skin and not inhaled. Four grammes of mercurial ointment are rubbed into the skin for half an hour; then the skin is cleansed with benzene, and all superfluous ointment removed. In thirty-two cases the gums were affected, and it was found that the number of inunctions required to produce mercurial stomatitis was practically the same as when the ointment was left on the skin.

Queyrat (2) advocates *argentic grey oil,* containing forty per cent mer-

cury and twenty per cent silver, given in a series of weekly injections, after a series of injections of salvarsan.

Krefting concludes: (1) In sero-negative primary disease five injections, at fortnightly intervals, of large doses of salvarsan (0·50-0·60 gramme for men and 0·30-0·40 gramme for women) appear to be sufficient. (2) In sero-positive primary disease, the first five fortnightly injections should be followed by a certain number of additional injections at intervals of three to four weeks. (3) As a rule, salvarsan alone is also capable of controlling the disease in the secondary and tertiary stages.

Linser's device of giving salvarsan and mercury together in the same intravenous injection has been tested by Boas and Pontoppidan in seventy cases in every stage of the disease, but not including general paralysis or congenital syphilis. Either neo-silver-salvarsan plus novasurol or neo-silver-salvarsan plus cyarsal was given, the dosage being 0·2 gramme plus 1 cubic centimetre at the first injection, 0·3 gramme plus 2 cubic centimetres at the second injection, and finally 0·4 or 0·5 gramme neo-silver-salvarsan plus 2 cubic centimetres novasurol or cyarsal. Altogether, a course of six injections was given, the intervals between each injection being usually one week and sometimes half a week. In most cases this course was followed up by four injections of ten centigrammes of o cinereum with a view to leaving a depôt of mercury in the body. Boas and Pontoppidan have nothing but good to say of this procedure; there were no local ill effects, and an occasional and slight febrile reaction was interpreted simply as "spirochæte fever." The disappearance of clinical and serological signs of syphilis was rapid, and there was no neuro-recurrence, and no clinical or serological relapse. But the observation period was only six months or less. The conclusion to be drawn is that this procedure is quite as safe and effective as any other, and from the purely technical point of view it marks a definite advance; simplification of the treatment of syphilitics, many of whom are apt to revolt against inunctions and intramuscular injections, is a very important matter.

Mehrtens finds that the *rectal administration of arsenobenzene* is effective if large doses are given. By gradually increasing the dose he found that four grammes of neoarsphenamine could be given safely at intervals of ten to fourteen days. A purgative was given the day before and the colon washed out two hours before the injection. Tincture of opium, or a hypodermic injection of morphia, was given at the time of injection. The drug was administered in a solution of 100 cubic centimetres, and retained for twenty-four hours if possible. Mehrtens found that when given in these large doses the amount of arsenic in the blood was equal to or greater than that with intravenous injection of 0·6 gramme of the drug, and that the amount excreted in the urine was greater. Arsenic was also found in the spinal fluid, and some cases of neurosyphilis treated by the rectal method improved as much as by intravenous injections. The only sign of toxicity was occasional vomiting in some of the cases.

Steinberg reports that the addition of *grape-sugar* to arsenobenzene renders it more effective. When an intravenous injection of thirty cubic centimetres of a thirty per cent solution of grape-sugar was followed in six or eight hours by an injection of 0·2 gramme only of neosalvarsan, or when the two were injected together, the therapeutic effect was equal to that of the usual dose of neosalvarsan. He states that the combination is twice as active as neosalvarsan alone. He also found that the rate of excretion of the arsenical compound was diminished, but that its toxicity was also less.

Escher, from personal experience of 1,400 injections, and from a study of the literature, concludes that arsenobenzene combined with silver, either in the form of Danysz's *luargol* or Kolle's *silver-salvarsan*, is equal to the old salvarsan in therapeutic effects, with smaller doses, and is less toxic. In his experience the side-effects are negligible. He found only one case of argyria and four fatal results in the literature.

Michelson and Siperstein, from a review of the literature and from their own experience, sum up the position of *silver-salvarsan* as follows: it has a pronounced effect on the clinical manifestations of syphilis in smaller doses than those usually given with other arsenical preparations, but whether this effect is more lasting requires further observation. The immediate reactions are about the same as with the other preparations; hæmorrhagic encephalitis was only reported once. No authentic case of argyria has been reported. In the majority of cases of recent syphilis the Wassermann reaction becomes negative after six to ten injections. The superiority of silver-salvarsan over the other arsenical preparations is not so distinct that it should be preferred to them, and there is no evidence that it has a selective action on the nervous system. The doses recommended are 0·05 to 0·1 gramme for the first dose, afterwards 0·2 to 0·25 gramme. The dose is dissolved in 10 cubic centimetres of distilled water, administered in a 20-cubic centimetre syringe, and 10 cubic centimetres of blood withdrawn into the syringe before the whole is injected. Mercurial treatment is advised separately, not concurrently.

Ziegler finds that *neo-silver-salvarsan* has a good therapeutic action but no distinct superiority over the older preparations. The side-effects were similar, and in 250 patients thus treated there were four cases of severe dermatitis and two of late icterus.

Voegtlin, Dyer and Thompson, in a study of *sulfarsenol*, find that its toxicity is about equal to that of neosalvarsan, its trypanocidal power slightly less, and its rate of excretion approximate to that of salvarsan.

Ravaut (1) classifies the *accidents caused by arsenobenzene* as follows: (1) those due to technique; (2) reactional phenomena, general and local; (3) phenomena due to humoral troubles; (4) toxic phenomena. Accidents due to *technique* have been much reduced of late, especially since the intro duction of the method of concentrated injections (eight to ten cubic centimetres), which avoids those caused by impurities in the water when injec-

tions are given in larger bulk. The *general reactional phenomena* include pyrexia and Herxheimer's reaction, both of which Ravaut attributes to the reaction between the drug and the irritated tissues. They can be avoided by beginning with small doses, or by giving mercury first. The principal *local reaction* is the "neuro-relapse," affecting the cranial nerves weeks or months after completion of the arsenical course. This was frequent with the old salvarsan, but is now rare. According to Ravaut, it only occurs when the nervous system is already affected and in badly-treated cases, and is due to blocking of the meningeal vessels by inflammatory reaction after too violent treatment, thereby preventing the drug reaching colonies of spirochætes which remain active and cause the neuro-relapse. According to Ravaut, the chancriform lesions which simulate re-infections may be explained in the same way. Colonies of active spirochætes may also be isolated when the circulation is blocked by precipitates, due to deficient alkalization of the solution of the drug. This explains why neuro-relapses are less common with the more easily soluble neosalvarsan than with the old salvarsan. Ravaut thinks that oxidation of the drug *in situ* may also play a part in blocking the circulation. Another local reaction is the "hepatic relapse" with icterus. This is sometimes of syphilitic origin, but more usually toxic. These local reactions are due either to excessive or to deficient arsenical treatment. Being syphilitic in nature, they should be treated with gradually increasing doses of arsenobenzene. Phenomena of *humoral origin* are divided by Ravaut into transitory and permanent. The transitory phenomena include nausea, vomiting, syncope, tingling of the extremities, abdominal pain, diarrhœa, salivation, swelling of the lips, ethereal taste in the mouth, rapid pulse and respiration. These symptoms are not dangerous in themselves, but may precede more serious symptoms. Treatment should be suspended. "Nitritoid crises," manifested by congestion of the face and conjunctiva and dyspnœa, may be transient or persistent and severe, with loss of consciousness, convulsions, and coma. Such cases are now rarer. The causes of these phenomena may be found in the technique (too acid solution, too rapid injections, etc.), in impurities in certain series of the drug, in individual predisposition with suprarenal or hepatic disorders. Ravaut thinks that oxidation of the drug may here also play a part. Hence there are several factors varying in different patients and in the same patient after different injections, and it is necessary to determine whether these concern the patient, the drug, or the technique. If the cause lies in the patient, adrenalin is useful both as a preventive or curative measure, but is not infallible, and sometimes causes unpleasant symptoms. Ravaut recommends five to ten centigrammes of neosalvarsan by the mouth an hour before injection. The permanent humoral phenomena occur after every injection and are not prevented by the above measures. They are characterized by constancy of type and time of appearance in each patient, and include pyrexia, tremor, congestive crises, vomiting, erythematous eruptions, purpura, and hæmorrhages. Sometimes they are attenuated by

giving diminished doses, changing the drug, or using preventive measures, such as adrenalin, or ten centigrammes of neosalvarsan by the mouth. Intramuscular causes the same phenomena as intravenous injection in these cases, which are difficult to explain except by anaphylaxis. The *toxic phenomena* are of later onset, after several injections or after completion of the course, but may occur earlier if the organs concerned are already affected with syphilis. The chief lesion is arsenical hepatitis with icterus, which cannot be distinguished from syphilitic hepatitis. The test of proteopexic shock proposed by Widal and Abrami shows the high toxicity of arsenobenzene for the liver, which manifests diminished function during and after treatment. The treatment for these cases consists either in the substitution of mercury or suspension of all treatment. Ravaut (2) mentions a case of icterus appearing two months after cessation of arsenical and mercurial treatment in which resumption of the same treatment, on the assumption that the icterus was syphilitic, led to a fatal termination. Another toxic phenomenon is exfoliative dermatitis, which Ravaut attributes to increased oxidation. For this he recommends hyposulphite of sodium, either by the mouth or by intravenous injection. Toxic nephritis is rare with arsenical compounds; more common with mercury.

In the report of the Salvarsan Committee of the Medical Research Council on *the toxic effects of arsenobenzol preparations* no difference was found in the liability of this or that preparation of arsenobenzol to produce ill effects. Some of the ill effects are attributed to the arsenic, the chief of these being gastritis, enteritis, and exfoliative dermatitis. The vasomotor phenomena, "nitritoid crises," and liver affections are attributed to arsenobenzol poisoning rather than arsenic. The theory of an intercurrent microbic infection of the liver, suggested by some, is not favoured. The Committee conclude that there is evidence that a course of arsenobenzol is nearly always followed by a certain degree of hepatic insufficiency which can be discovered by certain tests. The tests employed were the lævulose toleration test and the estimation of lipase, or fat-splitting ferment, normally present in the blood. Mackenzie Wallis, who carried out these tests, found that hepatic insufficiency was almost always present when the tests were made three months after a course of arsenobenzol, although clinical signs might be absent; but, six months after the last injection, the insufficiency disappeared. If these observations are confirmed they have a bearing on the intervals between the courses of arsenobenzol.

Duhot records that he has been able to prevent many of the ill-results of arsenobenzol injections by giving them in a fifty per cent solution of glucose. He takes about two cubic centimetres of the arsenobenzol solution in a syringe and then draws up eighteen cubic centimetres of the glucose solution.

Jeanselme and Pomaret have experimented with a new organic arsenical preparation—*amino-arseno-phenol*. This is the basis of Ehrlich's "606," but was abandoned on account of its insolubility. Pomaret has succeeded

in making an alkaline solution of amino-arseno-phenol, which he names "132." This preparation is said to be non-toxic although it contains forty per cent of arsenic. According to Pomaret, the lateral chains in the salvarsan series cause toxicity and are therapeutically valueless. Amino-arseno-phenol was found to be as efficient as "606" in the spirillosis of fowls and the experimental syphilis of rabbits. Jeanselme, Bloch, and Pomaret have used this preparation in 150 cases of human syphilis. *S. pallidum* disappeared from chancres in three or four days, mucous and cutaneous syphilides healed rapidly, and the Wassermann reaction became negative in all primary cases and in all secondary cases which had received a total of 2·80 grammes in the course of fifty-three days. Administration was by intramuscular injection, in doses of 0·12 centigramme. In forty-one cases which were intolerant of intravenous injections of arsenobenzene, including eleven with nitritoid crises, intramuscular injections of amino-arseno-phenol were well tolerated, except in four cases of exfoliative dermatitis, which recurred. The authors conclude that intramuscular injections of "132," in equal doses of arsenic, give serological and therapeutic results equal to those obtained by intravenous injections of "606." They point out that intramuscular injections in general avoid the dangers of shock, nitritoid crises, and serous apoplexy, and that injections of "132" are painless, cause no local reaction, and are rapidly absorbed, as shown by the appearance of arsenic in the urine. Lepinay has tried "132" by both intramuscular and intravenous injection, and concludes that the intramuscular route is quite as effective and generally painless.

Levaditi and Navarro-Martin (1) (2) have investigated another arsenical preparation, the sodium salt of *oxy-amino-phenylarsenic acid*. This is stable and soluble, contains about twenty per cent of arsenic and is of low toxicity. In experimental syphilis of rabbits this drug was found to have a curative effect both by subcutaneous and by oral administration. In a macacus monkey inoculated with human syphilis the chancre healed in six days after two doses of 1·50 grammes given by the mouth. In the human subject a similar result was obtained. The drug was given as a ten per cent solution in daily doses of 1 or 2 grammes (fasting), to a total of 14 or 16 grammes, with no bad effect. The prophylactic effect of this preparation was also tried in the human subject. A man was inoculated in both arms with syphilitic virus; two grammes of the drug were given two hours and sixteen hours afterwards. No chancre developed and the Wassermann reaction remained negative for forty-seven days. Monkeys inoculated with the same virus developed chancres. It is claimed that the new preparation has both a curative and prophylactic effect in syphilis.

Sazerac and Levaditi (2), from further investigations on the *bismuth treatment* of syphilis, find that the tartro-bismuthate of potassium and sodium is more stable and less toxic than other preparations, such as the ammonio-citrate, lactate, and subgallate. It is best tolerated in the form of an oily suspension by intramuscular injection. The therapeutic action

is rapid on primary, secondary, and tertiary lesions, effective on adenopathies, and produces a negative Wassermann reaction.

Müller has tested in twenty-five cases of syphilis a supply of potassium and sodium tartro-bismuthate (trépol) sent him by Professor Levaditi. Every adult was given two grammes by intragluteal injection every fourth or fifth day, and a course of treatment consisted of ten injections. The symptoms invariably disappeared promptly; more so than with injections of calomel, and as promptly as with silver-salvarsan. But the spirochætes did not disappear from the primary lesion till three days after the institution of this treatment. The behaviour of hypertrophic papules on the genitals was very uniform; on the fourth day these papules began to shrivel up, and after three or four days they no longer contained spirochætes. The clinical results were as good in tertiary as in primary and secondary syphilis. Albuminuria was not provoked, but it was almost impossible to avoid a narrow bismuth band on the gums. Provided the teeth were in a healthy state, this band did not necessitate discontinuation of the treatment. Jaundice was seen in one case, but its connexion with the treatment was doubtful. Lymphocytosis (10,000) occurred once in association with Herxheimer's reaction, and marked eosinophilia was frequently observed a couple of hours after an injection. The Wassermann reaction did not become negative as promptly as after silver-salvarsan alone or a combination of mercury with salvarsan. X-ray control of the injected bismuth showed that it had been completely absorbed by the third day. As it is very toxic by intravenous injection, great care should be exercised during an intramuscular injection to prevent any of the drug escaping into a blood-vessel. The clinical results were so good as to warrant further trial of this drug on a large scale.

Lévy-Bing, Gerbay, and Phillipeau obtained good results with intramuscular injections of the oily suspension of tartro-bismuthate of sodium and potassium, given in doses of two cubic centimetres at intervals of four or five days, to a total of 2·90 grammes. The chief drawbacks are pain, stomatitis, and the grey line on the gums. Milian finds that the incidence of stomatitis is reduced by giving the injections at longer intervals of five or six days. Bacteriological examination showed that the stomatitis is due to the fusiform-spirillar symbiosis, and biopsy showed that the pigment (bismuth) was deposited in the papillæ of the dermis. Hudelo remarks that bismuth stomatitis differs from mercurial in the slight salivation, integrity of the tongue, and more rapid response to treatment. He recommends applications of peroxide of hydrogen and methylene blue. Jeanselme finds that soluble injections of tartro-bismuthate in fifteen per cent glucose with 1·5 per cent phenol cause less pain and less liability to stomatitis. Lacapère and Galliot have tried intravenous injections of a colloidal preparation of bismuth, given thrice weekly in doses of fifteen cubic centimetres (thirty-three milligrammes of bismuth). The reactions are said to have been slight or absent. Marie and Fourcade report good

results from bismuth treatment in neurosyphilis, gummatous or arterial. Azoulay recommends iodo-bismuthate of quinine in a ten per cent oily suspension, given intramuscularly in doses of thirty centigrammes two or three times a week. Sézary and Pomaret advise simultaneous treatment with bismuth and arsenobenzene. As the arsenobismuth preparation devised by Ehrlich in 1913 is unstable, they used the new preparation amino-arseno-phenol mixed with soluble tartro-bismuthate in the same syringe. Intramuscular injections of 12 to 25 centigrammes of the former and 10 centigrammes of the latter were given at intervals of two to five days. The addition of the arsenical compound is said to prevent stomatitis.

According to Démelin, bismuth appears in the urine 18 hours after an injection of the citrate, and 24 hours after injection of an insoluble preparation, such as the bismuthotartrate, and can be found in the urine 20 days after the last injection of the latter, which shows its prolonged action. Bismuth is also excreted by the intestines, sweat, and salivary glands. In one case Démelin found bismuth in the cerebrospinal fluid after three injections of bismuthotartrate.

A Method of Blood Culture in Undulant (Malta) Fever and other Diseases (*South African Medical Record*, vol. xxi, No. 14, July 28, 1923).—L. J. J. Orpen, after reviewing methods advocated by Bassett-Smith, suggests trial of the following method which has been successful in his hands. Ten cubic centimetres of blood are taken into a centrifuge tube containing ½ to 1 cubic centimetre of 10 per cent citrate. Saline is added, and the whole is centrifuged at a good speed for fifteen or twenty minutes, so that both red cells and organisms are thrown down. The saline and centrifuging are repeated twice. The deposit (consisting of about 4 cubic centimetres of washed reds and organisms) is then taken up in a pipette and 1 cubic centimetre added to each of four tubes of ordinary agar (10 cubic centimetres melted and cooled to 45° C.). Plates are poured at once and incubated at 37° C.

With the above method the organism can be picked off for identification in a few days (for colonies may show up as early as the end of the second day, or may be as late as the sixth day); positive results are now more frequently obtained; and contaminations are unimportant, as they form separate colonies in the plate.

With a very few organisms serum is necessary for growth. This can be added in the form of any animal serum which is not inhibiting, or the patient's decomplementized serum could be used, provided that its inhibitory effect is not due to agglutination as mentioned above.

With other organisms citrate helps growth (see an article in the *Lancet* of January 1, 1921, which gives a useful list of organisms whose growth is increased or inhibited respectively by citrate). This could be added by using citrate in the saline used for washing in the method given above.

Reviews.

THE RELATIONS BETWEEN HOME CONDITIONS AND THE INTELLIGENCE OF SCHOOL CHILDREN. By L. Isserlis, M.A., D.Sc. Medical Research Council. Special Report Series, No. 74. $9\frac{3}{4} \times 6$. Pp. 28. Stationery Office: 1s.

The title sufficiently describes the purport of the inquiry of which the results are published in this report. It raises again the old question of nature versus nurture, and in spite of the conclusions arrived at, the true answer is not yet clear.

Observations of this type are obviously subject to considerable error if only through the fact that "the person assessing the intelligence of the child and his general social status is the same in both cases" (usually the child's class teacher) and subconsciously tends to form judgments in accordance with the results he wishes to obtain; further that the teacher is influenced by factors that are of little weight, occasional successes in school, age, clothing and cleanliness.

Mrs. Francis Wood began in 1913 an elaborately controlled inquiry, unfortunately incompletely recorded at her death in 1919. Dr. Isserlis then took over the work, completed the analysis and wrote this report.

The children in three of the L.C.C. schools which dealt with rather different types of pupils, were classified according to grades of intelligence and of social position by their class teachers. To obtain some measure of the difference between these schools, two or three classes in each school were asked to work certain psychological tests of the well known type. A very comprehensive schedule was completed by the teacher for each pupil; this included easily defined grades both of intelligence and of social status, of type and sufficiency of clothing, while height, weight, cleanliness, and state of nutrition, were obtained from the medical cards, not, however, for the same year as that in which the intelligence was tested. Further, the period during which the child had been fed at school was also noted. Obviously these schedules afford material for analysis in many different ways.

It is unnecessary to pursue the course of the investigation through its various stages of partial results and cross checks. The following are the main conclusions which have been arrived at after what appears to be adequate inquiry:—

(1) The psychological tests are significantly correlated with the teachers' estimate of intelligence, and such tests may be employed legitimately for the purpose of obtaining uniform standards for grading intelligence.

(2) "There is a distinct correlation between the intelligence of the school children and their environment, whether measured by the economic position of their parents, by the care taken of the home, or by the clothing of the children. The partial correlations for constant age are uniform in sign, of order 0·3 to 0·4 and five or six times greater than their probable errors." This may be put (as by Mr. Cyril Burt, M.A., in his introduction) in this way "that the importance to the child of social circumstances is as one in three."

(3) There is no significant difference in these respects between boys and girls.

Two further conclusions point to the necessity for a further investigation into physique, intelligence, environment, using contemporaneous data, and to the probability that further improvement in home conditions may be expected to react favourably on intelligence as well as health.

R. J. S. S.

REGISTER FOR RECORDING ALL PURCHASES, SALES AND STOCK OF DANGEROUS DRUGS. Bristol: John Wright and Sons, Ltd. London: Simpkin, Marshall, Hamilton, Kent and Company, Ltd. 1923. Price 3s. 6d. net.

This book is a register measuring 8¼ inches by 5 inches, which should fit easily into a cupboard where there are stored drugs described as "dangerous" under the Dangerous Drugs Act 1920.

As a preface, various extracts from the Home Office Regulations are noted for guidance, while the body of the book forms a register of all transactions in regard to these drugs. These tables are printed on different coloured paper (with a "thumb index" for easy reference) for morphine, etc., heroin, etc., cocaine, etc., and medicinal opium.

The book will prove very useful to practitioners and pharmacists in civil practice.

A MONOGRAPH ON GONORRHŒA. By A. Keith Fraser, M.D. London: Henry Kimpton. 1923. Pp. 508. Price 18s.

This book is a valuable contribution to the ever-increasing number of books on venereal diseases. English authors are now rapidly overtaking the Continental writers in this subject and the number of volumes published each year is increasing.

The book on the whole is an excellent monograph on the subject. The chapter on pathology is rather florid and too theoretical. The author would appear to be much too optimistic in the treatment of gonorrhœa by vaccines and by chemio-therapy.

As regards the urethroscope, Dr. Fraser appears to be rather afraid of using this valuable means of diagnosis and treatment, and to exaggerate the dangers, and would put off an examination until three or six months

have elapsed after the supposed cure. The number of patients who would return for examination after this space of time would certainly be few. We must regret the absence of coloured drawings of the normal and pathological urethra. The chemical irritation test of cure is not so dangerous as the author would have us believe.

Except for the above mentioned faults the book gives an excellent account of the disease. It is well printed and has many illustrations, a large number of which are by the author himself.

The bibliographies at the end of each chapter and at the end of the book are very valuable. We recommend everyone who treats diseases of the urethra to read this book.

F. C. D.

CONTRACEPTION (BIRTH CONTROL): ITS THEORY, HISTORY AND PRACTICE. By Marie Carmichael Stopes, D.Sc., Ph.D. Published by Bale, Sons and Danielsson, Ltd. Price 12s. 6d.

This book contains a great amount of useful information and reasoned advice, that is not to be found in any other book that we know of.

The average medical man when consulted upon the subject of birth control, or necessary contraception, is incapable of giving sound practical advice and makes suggestions that not infrequently lead to estrangements and unhappiness.

To gynæcologists there is little that is new in the book, but for the general practitioner it will be found a most useful book of reference.

The author is to be congratulated, firstly, for the courage of her convictions in publishing this book, and secondly, for the clarity and delicacy with which she has expressed herself.

E. L. M.

Correspondence.

R.A.M.C. SCHOLARSHIP AT CHELTENHAM COLLEGE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—I venture to ask that you will publish this letter, on the ground that it may be of some consequence to the sons of present or past Officers of the Royal Army Medical Corps.

I believe it to be pretty well known that there is an annual scholarship of approximately £50 at Cheltenham College, awarded by competition at the time of our ordinary scholarship examinations, for the sons of Officers of the Corps. The first preference is given to the sons of Officers who fell in action—first Regular Officers, second Territorial or Temporary Officers. Failing such a candidate of adequate merit, the award may be given to the son of a serving Officer. Again failing a candidate of this description, the

moneys may be applied to the assistance of any boy eligible under the above heads, even though his standard of work is not up to scholarship or exhibition form, but in this latter case the boy would not have the title in our School Records of "R.A.M.C. Scholar or Exhibitioner." It is this last category that I think has not yet been made clear.

These conditions were laid down by the Royal Army Medical Corps Memorial Committee, who founded the Scholarship here which we have the honour to administer. Details about the examination in 1924 may be obtained from the Bursar, Cheltenham College.

The College, Cheltenham. Yours faithfully,
October 25, 1923. H. H. HARDY,
Head Master.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subcriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to THE HON. MANAGER, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," WAR OFFICE, WHITEHALL, S.W. 1.

All Applications for Advertisements to be made to—

G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C. 2.

VOL. XLI. DECEMBER, 1923. No. 6.

Journal
of the
Royal Army Medical Corps.

Original Communications.

THE EVACUATION OF THE SICK AND WOUNDED ON THE NORTH-WEST FRONTIER OF INDIA.

BY CAPTAIN E. B. MARSH, M.C.
Royal Army Medical Corps.

PART I.

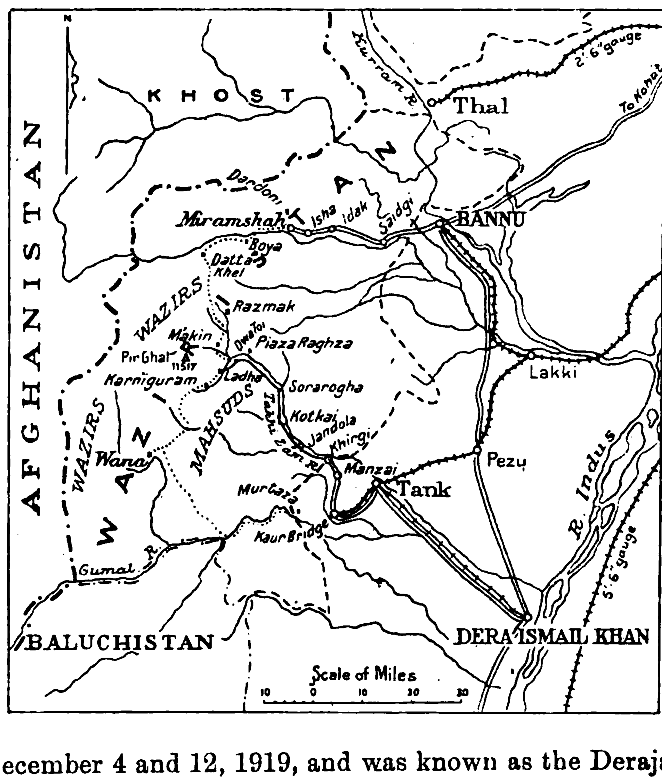
DURING recent years many articles have been written concerning the evacuation of sick and wounded of fighting formations when operating in a civilized country such as France. In this article it is proposed to describe some aspects of the work of the front line Medical Service when operating with troops on the north-west frontier of India where warfare is of an entirely different nature, owing to the mountainous and almost woodless terrain, the absence of buildings of European type or, indeed, habitations of any kind, and the long distances between fighting zones and bases over which the difficulties of transportation are but slightly mitigated by the existence of railways. Variations in temperature from extreme heat in summer to intense cold in winter have also to be taken in account. All the above factors are more or less common to the entire extent of the north-west frontier. They are the outstanding features of the Mahsud territory of Waziristan which was the scene of the military operations in 1919-1920, that afforded the experience upon which this narrative is based.

It will be remembered that the Waziristan tribes—the Tochi Wazirs, the Mahsuds, and the Wana Wazirs—rose in revolt against us on the outbreak of the Afghan War in May of 1919. On the conclusion of peace with Afghanistan, in the late summer of that year, it was decided to dictate terms to the tribes, and, if they did not accept and comply with these terms,

to launch military operations with a view to occupation of the tribal territory, and particularly the Mahsud country, until our terms were complied with. An advance in force up the Tochi valley was accordingly commenced in November, 1919, by a column designated the Tochi Column. On the appearance of this force the Tochi Wazirs, the less resolute and more vulnerable tribe, at once submitted, accepted the terms imposed and the operations of the column in that area terminated on November 27, 1919.

The Mahsuds, however, refused the terms, as infringing their independence, and military operations were consequently undertaken with the definite object of subjugating and occupying their country. The force employed for this purpose concentrated at Tank and Khirgi (see figure I)

Figure I



between December 4 and 12, 1919, and was known as the Derajat Column. It is intended to discuss here only the work of evacuation of sick and wounded of this column.

The preliminary advance up the Tochi Valley yielded few sick or wounded, but the work connected with their disposal afforded the medical units, which were afterwards transferred to the Derajat Column, an excellent opportunity of discovering and rectifying faults and deficiencies before being thrown into contact with the heavy fighting subsequently

encountered in the advance against the Mahsuds. A brief description of the geographical features of the Mahsud country and its inhabitants will be helpful in appreciating the difficulties met with in details concerning the evacuation service during warfare of the nature in question.

The Waziristan terrain consists mainly of interminable barren rocky mountains of from two to eleven thousand feet elevation above the desert plain of Dera Ismail Khan. The mountains are intersected by numerous stony ravines or nullahs and they rise extremely steep from the interlacing valleys through which a river or stream may flow. The nullahs afford excellent places of ambush. The route traversed by the Derajat Column lay through the valley of the Tank or Takhi Zam. This river is formed by the junction near the village of Dwa Toi, of two watercourses named the Baddar Toi and the Dara Toi. The source of the former is in the region of Karniguram, and the latter on the slopes to the north and west of Makin. These two villages are the largest in Waziristan. In Makin and its vicinity the most truculent tribesmen live. The bed of the Takhi Zam forms the natural highway from Khirgi into the heart of the Mahsud country. Except at four places—the Ahnai and Barari Tangi, Dwa Toi and Marobi—where the valley narrows to a mere gorge with precipitous rocky hills on either side, the route is broad and spacious and affords ample room for troops and baggage animals to march four or five lines abreast. The river bed is composed of boulders and stones of all sizes and in the course of the running stream marked variations in the depth of the water occur. The river pursues a very irregular winding course necessitating frequent wading from one side to the other which renders marching a very tedious and, in places, difficult proceeding. The hills rising on each side of the river bed in its lowest reaches are characteristically ragged, barren and rocky, with very little vegetation. Higher up shrubs grow on the hillside, where the general elevation approximates 4,500 feet. These are mostly the gurgura (*Reptoria boxifolia*), a species of wild plum. As the altitude increases the better developed the shrubs become, whilst from Piaza upwards wild olive trees and the ilex are seen in profusion.

Every mile or so along the bed of the river there are patches of cultivation. These fields or plots are nearly all artificially constructed by the inhabitants, and are formed by revetments of timber, stones and brushwood run out from the river bank at right angles to the stream. Silting of mud is thus produced above these dams, and gradually quite extensive areas of rich cultivable soil are formed. The chief crops grown are wheat and maize. Sheep and goats thrive, in moderate herds, especially at the higher altitudes. The Mahsud did not appear to possess either cows or buffaloes, but, possibly, these animals were kept hidden owing to fear of confiscation.

The climate varies according to the altitude of the place. In the lower reaches of the river it is moderately cold in winter and intensely hot in the summer. Higher up the climate is more equable, and consequently more endurable without discomfort. At 5,500 feet the winter is very cold, the

temperature quite often dropping 10° or 15° F. below freezing point. In the summer it is distinctly warm during the day, but not unpleasantly so, and the nights are always beautifully cool, necessitating the use of a blanket. Rain and snow fall at intervals in the winter, chiefly in January and February. Bursts of extremely heavy rain often occur in July. As a result of these sudden thunder showers at that time of the year the river rises very rapidly. The water comes down in the form of a bank from three to six feet high, travelling at a rate of six to eight miles per hour. These "spates," as they are called, are frequently dangerous, as they give little time for men or animals to reach points of safety, especially if marching with a convoy of camels.

Inhabitants.—The inhabitants of Waziristan consist of the Wazirs and the Mahsuds—both are descended from the original Wazir, who belonged to the Kakai branch of the Ghurghusht Pathans. The two tribes, although of common origin, have been feudal enemies throughout very many years, but sometimes co-operate with each other against a common enemy, and they thus combined to oppose the British forces employed in the operations under discussion. The Wazirs are divided into two sections, the Wana Wazirs living in the country round Wana, in Shakai, and on the western border of Bannu, and the Tochi Wazirs who inhabit the Tochi and the Shawal districts and the valleys of the Kaisara, Kaitu, and Kunam rivers. The Mahsuds live in the heart of Waziristan, their territory being bounded on the north, south, and west by that of the Wazirs, and on the east by the Batannis country. Their chief villages are Karniguram (5,800 feet), and Makin (5,500 feet).

The points noted here concerning the characteristics of the Mahsud may be taken as being equally applicable to the Wazir. The average Mahsud is a fine robust, well-built man, about five feet ten inches in height. Muscularly he is very well developed, more especially about the legs and arms. His skin is of a pale brown hue, distinctly fairer than the northern Indian. His eyes are steel grey, at times looking almost blue. His normal raiment is of a very rough type, consisting of a dirty pagri, whitish, blue or red, tied rope fashion, round the temples. On his body he wears a grey, hand-woven woollen smock surmounting dirty white cotton pyjamas, and round the waist a piece of cloth, not unlike a Scotch plaid, which he uses as a blanket at night. Stuck into this waist cloth, and generally hidden away, every Mahsud carries a steel knife, many of which are manufactured at Karniguram. Some of these knives are beautifully decorated both on the blade and on the handle. In addition, they possess a very considerable number of rifles of all descriptions, including the modern ·303 magazine type in abundance and large numbers of Martini and other breach-loading rifles. The ancient breach loaders they never used during the 1919-20 operations except at night. They had no artillery, machine-guns, or bombs. On their feet they wear sandals or "chaplis," made of plaited grass or from the leaf of the dwarf palm.

They are amazingly mobile, independent of transport, and they possess a genius for ambush and taking cover. They are excellent shots and rarely fire blind. Many of them have served in the Indian Army and some, no doubt, have been highly trained in our tactics and methods of fighting. They are certainly no fools and they possess a keen sense of humour. Their dwellings are chiefly made of mud and straw with interlacing wattle and beams of rough wood. They also use caves, often cut deep into the side of a hill. These as it happened afforded them a perfectly safe refuge against attack from the air.

Their knowledge of medicine and surgery is extremely crude. After the occupation of Ladha an aid post was established outside the perimeter of the camp for the purpose of treating any of their sick or wounded who cared to come along. Many availed themselves of the opportunity. The degree of sepsis present in nearly all cases of wounds was appalling. Often a mass of maggots was exposed after stripping the wound of the filthy wrapping of cloth in which it was covered. As a rule it was very difficult to persuade the patient of the necessity for operation which, in many cases, meant amputation of a limb. The patient's friends generally preferred to take him away and trust to fate and a bottle of medicine or a pill. In the latter they had great faith. So far as my observations extended it was undoubtedly a case of trusting to the survival of the fittest amongst these people, who in so many other ways showed a comparatively high standard of intelligence and mental efficiency.

The above brief description of the Mahsuds and their country will indicate, to a certain extent, how widely the warfare in which they were involved differed from the warfare in Europe during the Great War.

The Derajat Column, which, as previously stated, assembled at Tank and Khirgi between December 4 and 12, 1919, was composed as follows:—

Column Headquarters Staff, one regiment Cavalry (less one squadron), one section 3·75 howitzers, two Indian Mountain Batteries with the Derajat Brigade Mountain Artillery Brigade Ammunition Column, two Field Companies Sappers and Miners, Survey Section, three Brigade Signal Sections, one Headquarters Signal Company, one Mountain Artillery Brigade Signal Sub-section, two Pack Wireless Stations.

Pioneers.—Two battalions of Pioneers, South Waziristan Militia Scouts.

Medical.—Two Indian Field Ambulances, one Combined Field Ambulance, one Bearer Unit, five Combined Staging Sections, one Sanitary Section.

Supply.—One division S. & T. Headquarters, one division Troops Supply Section, one division Supply Column, one division Supply Park, half a Bakery Section, and half a Butchery Section.

Transport.—Four Mule Corps, four Camel Corps.

Infantry.—Three Indian Infantry Brigades, each with four battalions, a Brigade Supply Section, half a Bakery Section and half a Butchery Section.

On the lines of communication behind the Column, on December 12, there were the following Medical Units : One Combined Casualty Clearing Station at Khirgi itself, intended for Jandola ; one Indian General Hospital at Manzai, one Combined Field Ambulance at Kaur Bridge, one Indian General Hospital at Tank, one Indian General Hospital at Dera Ismail Khan, one Motor Ambulance Convoy Headquarters at Manzai, one Ambulance train.

Railhead for sick and wounded was at Kaur Bridge. The actual striking Column normally consisted of: Two Mountain Batteries, one company Sappers and Miners, one Signal Company, one battalion of Pioneers, six battalions Indian Infantry, one Indian Field Ambulance, one Combined Field Ambulance, one Bearer Unit, a Supply Column carrying four days' rations.

The Derajat Column, the composition of which has been above stated, was commanded by Major-General A. Skeen, C.M.G., with Colonel T. Stodart, I.M.S., as A.D.M.S., assisted by Major T. S. Dudding, R.A.M.C., as D.A.D.M.S., who was also Sanitary Officer of the Column.

This Column was a part of the Waziristan Field Force commanded by Major-General S. H. Climo, C.B., D.S.O., with Colonel C. W. Profeit, C.M.G., D.S.O., as D.D.M.S., assisted by three D.A.D.sM.S., Major G. S. Wallace, R.A.M.C. (Water Purification), Major D. Cootts, I.M.S. (till January 14, 1920), Major J. W. Jones, D.S.O., I.M.S. (from January 14, 1920), and Major J. S. Sinton, V.C., I.M.S. (sanitation).

The Lines of Communication were commanded by Brigadier-General H. C. Tytler, C.M.G., D.S.O. as I.G.C. with Colonel Corry Hudson, D.S.O., I.M.S. as A.D.M.S., assisted by three D.A.D.sM.S., Major R. B. Myles, R.A.M.C., (to February 14, 1920), Major O. W. J. Wynne, R.A.M.C. (from February 14), Major H. H. Mulholland, R.A.M.C. and Major R. E. Flowerdew, I.M.S.

The headquarters of the Waziristan Force and the headquarters of the I.G.C. were both located at Dera Ismail Khan.

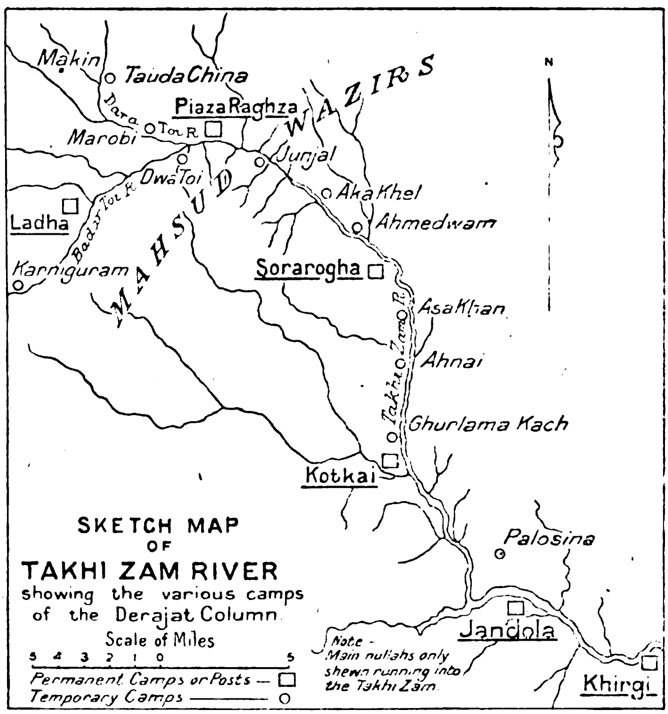
In addition to the administrative medical officers above enumerated there was an A.D.M.S. Advanced Lines of Communication, Colonel A. M. Fleming, I.M.S., who had his headquarters at Jandola.

The A.D.M.S. Derajat Column was responsible for the medical administration from the immediate area of contact with the enemy to a point midway between the location of the Column Headquarters' Camp and the next permanent camp towards the base, the A.D.M.S. Advanced Lines of Communication was responsible for the medical administration from this point down to Jandola, the A.D.M.S. Lines of Communication was responsible for the medical administration from Khirgi (road head) to Dera Ismail Khan, and the whole of the medical administration was commanded by the D.D.M.S. under the direct orders of the General Officer Commanding Waziristan Field Force. The map (fig. II supplemented by the diagram

fig. III) shows the geographical relationship of the concentration area, the area of operations and the lines of communication to the main base at Dera Ismail Khan.

This article is only intended to exemplify the difficulties or differences met with by the Medical Service in the forward area. To elucidate

Figure II



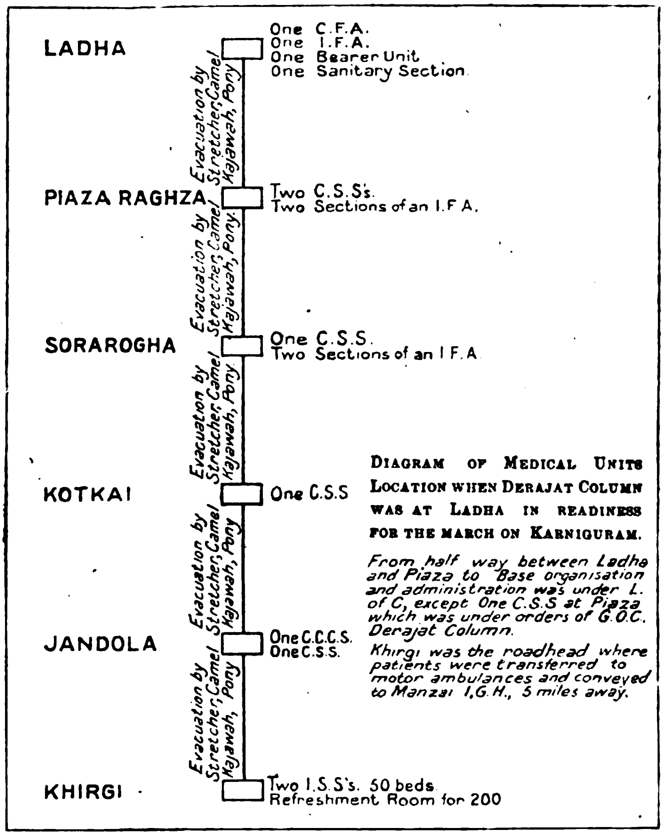
GLOSSARY OF PUSHTU WORDS USED ON THIS MAP.

Algad..	A water course or "nala."
Kach	An alluvial flat on the bank of river.
Kot	A walled or fortified village.
Palosi (Palosin).. ..	The dwarf babul tree (*Acacia modesta*).
Raghza	A flat terrace or plateau bordering a valley.
Sara (Sora)	Cold.
Tang (Tangi)	A gorge or defile.
Taud (Tauda)	Warm.
Toi	A stream (Dwa Toi—confluence of two streams).
Zam	A river.

these it is proposed, after describing the methods of transportation, to follow the fate of a wounded man from the time he became a casualty in the fighting front until he arrived at the stage of evacuation where his further progress came under the control of the authorities of the Permanent Lines of Communication at Khirgi. The medical formations and posts for dealing with the casualties in the forward area were organized on practically the same system as regards function and nomenclature as that

described in R.A.M.C. training, and familiar to all R.A.M.C. Officers who had experience in the forward areas in France during the Great War. There were regimental aid posts, advanced and main dressing stations, field ambulances and clearing stations. The latter in the area of operations were represented by combined staging sections. They were originally stationary hospitals organized as separate units for British troops and Indian troops, but were found unnecessarily unwieldy for the

Figure III



requirements of frontier warfare, and consequently they were reduced in size and became "staging sections," combined in the sense that accommodation was made available in such a unit for both British and Indian troops. The chief differences in the practical working of the front line medical service were in the methods and means of sick transport, the type of personnel employed, the staging of evacuation convoys, and the fact that the forward line of evacuation was through enemy territory and was liable to hostile attack throughout its entire length.

As the Column advanced into the Mahsud country from the concentration area around Khirgi, the distance from that place increased up to a total of forty-two miles when the main body of the Column occupied Karniguram on March 6th, 1920, and the immediate objective of the operations was gained. The journey of a wounded or sick man over the above distance usually took six days, halts for the night being made at Karnguram, Ladha, Piaza Raghza, Sorarogha, Kotkai and Jandola, posts where all sick convoys from Ladha to Kotkai were dealt with by combined staging sections, and at Jandola by a combined casualty clearing station.

During the earlier part of the operations when heavy casualties were expected, two sections of the reserve Indian field ambulance and one of the combined staging sections were actually located at the main column headquarters camp, and so placed that they were able to open up immediately if the necessity arose. The remaining two sections of the reserve Indian field ambulance and one combined staging section were within six hours recall, and the other three combined staging sections within twenty-four hours recall. The locations of the combined staging sections were determined under the order of the column commander. The normal procedure was to bring up the staging sections as the line advanced, and when suitable sites for permanent camps on the lines of communication had been selected. Thus, as the advance progressed into the heart of Waziristan the lines of communication extended. This necessitated the gradual transfer to the lines of communication command of certain troops, originally under the direct orders of the General Officer Commanding Derajat Column, and utilized for the protection of the lines of communication up to the immediate area of contact with the enemy.

A short description of the medical units enumerated in the order of battle is necessary, as they differ considerably from corresponding British Army units.

The medical personnel attached to an Indian infantry battalion consisted of one medical officer (a lieutenant or captain, I.M.S., T.C.), one sub-assistant surgeon,[1] or if not available, a dresser.

The regimental stretcher-bearers were sixteen to a battalion.

The Indian Field Ambulance.—As has been already stated in the order of the battle, there were on the strength of the Derajat column two Indian field ambulances and one combined field ambulance. At that time an *Indian field ambulance* was a field medical unit equipped to accommodate 100 Indian patients. It had no arrangements for the reception of European patients. The unit was divided into four sections, each com-

[1] Sub-assistant surgeons are Indians of good education who have undergone a four years' course at one or other of the medical colleges specially established for their instruction. Many of them are highly competent men, possessing a very sound knowledge of medicine. Dressers were young Indians who had not fully completed the course of sub-assistant surgeons, and in some cases were medical students temporarily withdrawn from their university during the war.

manded by an officer of the Royal Army Medical Corps or Indian Medical Service, and capable of working independently.

The Combined Field Ambulance[1] was a similar unit, with the exception that there was one British section and three Indian sections. The former was equipped in personnel and material for the reception and accommodation of twenty-five British soldiers, the total accommodation being 100 all in tents.

The Bearer Unit[2] was utilized to augment, when and where required, the bearer personnel allotted to regimental units and field ambulances, and was employed generally for collection and carrying patients, and supervising the transport arrangements for sick and wounded proceeding down the line. Further reference to its composition and work will be made later when discussing the transportation arrangements.

The Combined Staging Sections, as previously stated, were made up of one British staging section and one Indian staging section. These used to be known as British or Indian stationary hospitals. The combined unit was capable of accommodating 100 patients.

The establishments of the above medical units will be found in the Appendix to this narrative, together with revised establishments devised after the experiences of this campaign.

We now come to the *methods employed for the transportation of the sick and wounded* in mountain warfare. How to ensure reasonably rapid and effective means of transport of wounded within the limits imposed by the military operations, and the natural obstacles incidental to the circumstances of particular warfare, is one of the most important questions to be studied and duly appreciated by the medical service of armies. The question at all times demands the most precise preliminary consideration and provision of possible variations in practical execution, but this is so to a greater degree in mountain warfare than in any other. The preservation of the lives of soldiers disabled by injury or disease and the end results of surgical treatment depend directly on efficient means of transport and the initial manner in which the sick or wounded are handled, and not only does the efficiency of this service affect the physical welfare of the Army, but it also exercises a great and direct influence on the moral tone and degree of confidence in the troops, and consequently on the fighting results and ultimate success or otherwise in defeating the enemy. This was markedly exemplified in the recent European War in the case of the British Armies in France, where the methods and administration of the collection and transportation of the sick and wounded were carried out with an efficiency

[1] The Combined Field Ambulance is a creation of the war, and is a substitute for a whole British field ambulance which was found wasteful when the strength of British troops in a formation was not great.

[2] The Bearer Unit was mobilized from No. 3 Company Army Bearer Corps, Lahore, by Captain D. Reynolds, M.C., R.A.M.C., and commanded by him in the field.

never before attained in any previous campaign. There, however, apart from limitation of movement imposed by the enemy, the natural hinderances were negligible, and all the facilities afforded by good roads and railways and mechanical transport were available. The problem assumes a very different and incomparably more difficult aspect when applied to the roadless, mountainous terrain of Waziristan, where aid by modern mechanical vehicles and steam is inapplicable, and reliance has to be placed wholly on man power, assisted only by those primitive methods of animal transport which are determined by the natural conformation of the inhospitable terrain.

Consequently there were but three means available for transporting sick and wounded.

(1) By man carriage on stretchers.

(2) By ponies for riding.

(3) By camels carrying "kajawahs."

The use and peculiarities of these various methods in this campaign of 1919-20 will be referred to later when describing the journeyings of a patient from the time he was wounded down to his arrival at the base, but here an endeavour will be made to describe the type of carriage available with some historical remarks of interest concerning them.

Man Carriage on Stretchers.—The ordinary G.S. stretcher was used almost exclusively in the campaign and was found to be the best man-handled conveyance for the type of country and with the personnel available. All seriously wounded were carried by this means.

The modern dhoolies were not used for several reasons. Firstly in the forward area they were found to afford much too good a target for enemy snipers, secondly the constant fording of the river which in places came above the knee in depth made it difficult for dhoolie bearers to avoid wetting the patient, and thirdly the class of men available for carrying the dhoolies was not sufficiently versed in the best ways of carrying a dhoolie or accustomed to difficulties peculiar to these cumbersome articles which have to be overcome if patients conveyed in them are to be saved serious discomfort. The problem of providing good dhoolie bearers in Northern India is an extremely difficult one at the present time.

This form of transport in years gone by was the commonest in use in India, not only for sick and wounded, but also for ordinary progression from place to place. In the first half of the nineteenth century dhoolie bearers were so numerous in this country that they formed a considerable bulk of the labouring population, so much so that they composed a distinct caste called "Kahars." At that time and for many years subsequently the number required for the army could be recruited without the slightest difficulty; now, however, in the twentieth century, since the development of roads throughout the country, the advent of railways, motor cars and other forms of mechanical transport, the dhoolie has fallen into almost complete disuse except in a few districts where it is still employed by a very small

minority of the population. The result is that the true dhoolie bearers of India have almost become extinct, making it well-nigh impossible to recruit men of this class for the Army.

The difficulty of obtaining the right type of men for dhoolie bearers dates back to 1860, when General Sir William Mansfield[1], after his experiences when serving under Lord Gough in the Punjab and in the Peshawar Valley, wrote a very strong report on the subject. The following are a few extracts of the comments on the report:—

"There is nothing, therefore, in Sir William Mansfield's opinion, so much to be deprecated as reducing our old system of dhoolies and dhoolie bearers. On the whole he would rather see the number of combatants diminished than that of the dhoolie bearers. His experience is founded on observations of the campaigns of Lord Gough in the Punjab, which were altogether carried on away from metalled roads, on tedious operations in the Peshawar Valley, where there were no roads at all, and again in all recent affairs. As regards movable columns, it may be held as a certainty that they will always have to operate away from metalled roads. It should be borne in mind that dhoolie bearers should be kept up in India very much as if they were a breed of draught animals. The Finance Commission is possibly not aware that there is already a great falling off in this description of labour in consequence of great posting roads having been opened in late years. It may be assumed that, as the railway system becomes more and more developed, the dhoolie bearers will forget their craft, and devote themselves altogether to other labour."

Sir H. Rose, Commander-in-Chief in India, agreeing with the views expressed by Sir W. Mansfield, wrote:—

"There can be no doubt that for the requirements of India no system can be introduced more effectually than the dhoolies or dandies as heretofore employed, by which means wounded men could be transported from the hillside, broken ground, or other locality where they were struck down, to their respective hospitals, and that too over ground of any nature."

The above recommendations by two eminent highly experienced soldiers were apparently ineffective, for the histories of subsequent Frontier campaigns record the difficulties experienced in the evacuation of the wounded owing to the inefficiency of dhoolie bearers supplied.

Surgeon-Major Evatt in his "Personal Recollections of the Afghan Campaigns of 1878-79-80,"[2] remarks:—

"The convoy consisted of fifty European and thirty native sick. There was a mass of several hundred dhoolie bearers, undisciplined, practically unorganized and without any staff to keep them in order"; and again,[3]

---

[1] Report by the Officiating President of the Sanitary Commission for Bengal to the Secretary to the Government of India, Military Department, dated Calcutta, January, 1865.

[2] Journal of the Royal Army Medical Corps, vol. v, 1905, p. 589.

[3] *Ibid.*, p. 415.

"The native establishment given to work the hospital were wretchedly bad, literally and actually the lame, the halt and the blind, as Falstaffian a corps as any man could ever see, without discipline, without uniform, or drill, or arms or anything to distinguish them from the coolies of the Mian Mir bazaar."

Surgeon Major-General T. Maunsell, C.B., Army Medical Staff, late Principal Medical Officer Chitral Relief Force, remarked in his official report on the Chitral Relief Force of 1895,[1] that "Kahars were for the most part untrained and of poor physique and of the 'Chamar' class. In the hilly regions, partly owing to their poor physique and partly to the weight of the dandies, it took eight of them (occasionally twelve, and even more) to carry a European soldier, and even then got into camp late."

As a result of the many complaints made about the inefficiency of the then available dhoolie bearers, a proposal was put forward in 1901 for the formation of a corps of bearers, and in August, 1902, the Secretary of State authorized the formation of an Army Bearer Corps, which was to form an integral part of the Military Medical Service in India. From this date endeavours were made to enlist as many men as possible of the "kahar" class, who from their childhood had been used to carrying dhoolies, to form a nucleus, the requisite numbers to be made up by other men, the resulting corps to be trained in the carriage of wounded, first aid, drill and discipline. For this purpose a special staff was employed.

Before the advent of the Army Bearer Corps each regiment enlisted its own kahars, the regimental medical officers more or less acting as the recruiting officers. Each frontier force regiment had thirty-four kahars and one mate, and other regiments had six kahars. When the Army Bearer Corps was formed the regimental kahars were asked if they would transfer to the corps, but only a very small percentage agreed, and the majority preferred to return to their homes. The importance of having as many men of the kahar caste as possible amongst stretcher-bearers cannot be overestimated. These men are Hindus of high caste, and any Indian will receive water or food from them; this is of special importance in the case of field medical units. Again, these men are experts at carrying dhoolies or stretchers, because it is their hereditary job in life. The true kahar can always be recognized by the enlargement of the bursa over the shoulder caused by the constant friction and weight of the dhoolie pole. An ordinary Indian coolie finds it very difficult to carry a stretcher or dhoolie on the shoulder without getting a sore shoulder. In the Derajat Column it was found necessary to provide bearers with pads for the shoulders. This is important so long as the bearers employed are untrained to the carrying of heavy loads upon the shoulders. The following figures give the authorized establishment of the Army Bearer Corps from the time of its formation to 1919.

[1] A.M.D. Report for 1896, Appendix iii, paragraph 97.

From 1902 to 1906 the authorized establishment of the Army Bearer Corps was 6,000 men.

In November, 1907, when stretcher carriers were taken into use instead of the old heavy type of dhoolie, the establishment was reduced to an active list cadre of 1,500 men.

During the operations against the Mohmands and Zakka Khel early in 1908, the dhoolie bearers who had to be temporarily entertained were lamentable failures, and a committee assembled on August 3, 1908, to report on Indian ambulance transport, and recommended, amongst other things, that the peace strength of the Army Bearer Corps should be 5,500 men. Before this recommendation became effective there was a marked deficit in the number of Army Bearer Corps men serving on the active list, and for the Indian Army manœuvres of 1910 temporary bearers had to be entertained on contract at a flat rate of pay. After these manœuvres it was suggested that an Imperial Service Corps of ambulance bearers should be raised or formed, on the same lines as the Imperial Service Transport Corps, in those States where the old class of real kahar existed in sufficient numbers, e.g. Chamba. This proposal was dropped chiefly because the corps would be non-combatant, and therefore useless for assisting in keeping the peace, maintaining order, and for State ceremonies in native States.

In 1911 the authorized establishment of the Army Bearer Corps was still only 1,500.

In October, 1913, it was decided to gradually increase the number of men to 4,500 with a reserve of 1,500. By this time it was well recognized that it was not possible to recruit kahars in any large numbers and therefore special stress was laid upon the importance of the initial and subsequent training of the men in their bearer and other medical duties. The plan was to gradually increase the establishment yearly by 1,000 during 1913-14. by 1,000 plus 400 reservists during 1914-15, and by 1,000 plus 1,000 reservists during 1915-16,

Whilst this was being carried out the Great War broke out in August 1914, which materially altered the programme.

In February, 1915, the authorized permanent peace establishment was raised to 6,000, and at the same time the number was raised to 8,500 for the duration of the war.

In May, 1916, a further increase in establishment was sanctioned for the period of the war, bringing the numbers up to 14,500 men, and again in March, 1917, the numbers were again increased to a total in all of 19,000 men, which number proved sufficient until the end of the war.

The Army Bearer Corps men provided for these operations (1919-20) taken as a whole were much better than might have been anticipated. Relatively very few were of the true kahar caste, but a considerable number had seen service in one or other of the theatres of war during 1914-18 and were invaluable in teaching the younger men their craft.

All had been trained at one or other of the company headquarters of the Army Bearer Corps; they were willing, and, with a little supervision, maintained a smart appearance and good discipline. The Gurkhas and Garhwalies were particularly good and being accustomed from infancy to running up and down hills in their own homes were admirably suited to the carrying of patients over the type of terrain encountered.

A special feature of the campaign was the employment of the bearer unit which has already been referred to. This unit was formed as an experiment and proved sufficiently successful to merit its inclusion in the permanent war establishments since authorized. It was organized in two double companies each commanded by an officer, sub-divided into half companies each commanded by an assistant surgeon. When in the area of operations and not actively employed, these officers and warrant officers were able to devote their whole time to the supervision of the bearers with the result that the discipline, personal appearance and efficiency of the men reached a very high standard. On parade the men looked smart and soldier-like and before the end of campaign developed a marked *esprit de corps.* When not employed for the carrying of sick and wounded the bearer unit lent parties of men to combatant units for carrying water to pickets, making sangars, etc., thus relieving a proportion of sepoys who would otherwise have had to do the work, and enabling them to be sent for bathing or other fruitful exercise for the benefit of their health.

(*To be continued.*)

ON LABORATORY DIAGNOSIS IN THE TROPICS AND SUB-TROPICS IN WAR TIME.

By PHILIP MANSON-BAHR.

(*Continued from p.* 333.)

Diphtheria.

The provision of adequate means of laboratory diagnosis of diphtheria is very important also from a military standpoint. But it is doubtful whether this can be fully undertaken by a forward diagnosis unit. It entails the provision of sterilized throat swabs in sterile tubes, the direct inoculation of the swabs on to suitably prepared Loeffler's medium, and its subsequent incubation. It was found to be a matter of considerable difficulty to prepare satisfactory Loeffler's medium in the field. Sheep's serum does not congeal sufficiently solidly for the purpose, but (when obtainable) camel's serum was found to be satisfactory. It should be the duty of a base laboratory to prepare and supply the field laboratories with an adequate amount of Loeffler's medium for diphtheria diagnosis, and it must always remain the duty of the latter to perform this diagnosis, if necessary, on a more extended scale.

The Institution and Organization of the Diagnosis Unit.

Consideration of the facts detailed above, and the necessity of conserving the numbers of European troops, in view of the menacing military situation in France, led at the beginning of 1918 in Palestine to the establishment of this new unit—the diagnosis station.

The conception of these diagnosis units was that they should be—

(*a*) Extremely mobile.

(*b*) Self-contained and possess their own transport.

(*c*) Able to perform a large amount of work at a very rapid rate.

The personnel consisted of one Royal Army Medical Corps Officer and two orderlies, especially trained in rapid methods of diagnosis as detailed above. The unit and its equipment was so designed as to be transported in a G.S. wagon drawn by four horses or mules. They were, therefore, extremely mobile, their equipment was so simple that they were able to commence work at short notice, and were able to accompany the cavalry divisions on any rapid advance into enemy territory. These units, which were trained and equipped for work in May, 1918, continued to do good service throughout that summer. They fulfilled their most important function in the momentous advance in the autumn of that year, and each unit eventually became a laboratory centre on a line extending over more than 300 miles.

Six of the units were equipped and two were assigned to each of the three Army Corps which went to make up the Egyptian Expeditionary Force. The location of these units in the field was a matter of considerable deliberation. As previously stated, under ideal conditions, their location should be somewhat in advance of the field ambulance so as to be in touch with regimental medical officers. Wherever possible this was accomplished, but as a general rule it was found most suitable to attach such a diagnosis unit to one centrally placed field ambulance mainly for the purposes of rations, in a location easily accessible to other field ambulances, or in some sheltered position where one or more ambulances had been located, thus forming a collecting station. The diagnosis stations in this latter situation obtained the greatest opportunities for work, and from the returns available, herewith reproduced, they seem to have been well patronized throughout.

Details of Personnel and Equipment.

Personnel.—One officer; two specially trained Royal Army Medical Corps orderlies (training to be detailed later); one British and one native driver.

Equipment.—Tents, C.D.L. (bell tents), two (one for medical officer and one for orderlies); tents, I.P.G.S., 160 lb., one.

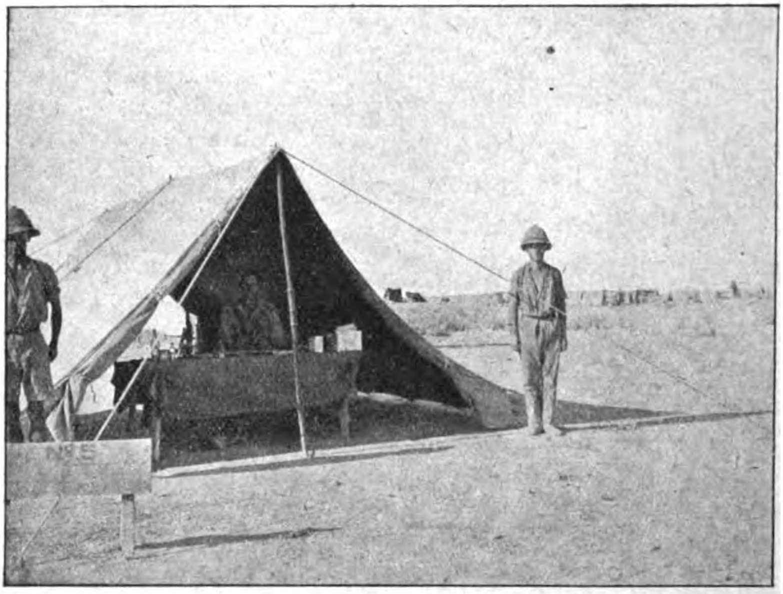
This light tent (see illustrations) was found to be most satisfactory. It was easily portable and erected, and if the ground space was well excavated, a very handy and comfortable laboratory could be made.

Tables, G.S., six feet, three (these made good and stout laboratory tables); forms, dining, three; lamps, F.S., paraffin, four. The ordinary hurricane lamp, if arranged so that the edge of the flame impinges on the mirror of the microscope, makes a suitable luminant for night work. Microscopes (fitted with oil immersion lenses), two.

It was found that two microscopes were ample for each unit. They had to be provided with a mechanical stage, and whenever possible with spare lenses. The work could then be performed by the officer in charge and one orderly, while the other was employed in cleaning up and other necessary duties.

Wagon, G.S., one; mules or horses, four. If need be, the outfit could be transported by pack mules or camels.

Each unit was provided with six or more gross of microscope slides, a stock of fully prepared Leishman's stain, a gallon cask of neutral distilled water, pipettes, grease pencils, two spirit lamps, cedarwood oil, methyl alcohol in ampoules of 100 cubic centimetres, methylated spirit, two quarts; glass rod, four feet; two porcelain staining troughs, twelve by ten inches. The total laboratory equipment, with the exception of the microscopes, could be packed away into two empty kerosene tins. It was estimated that such a unit was capable of examining and reporting upon 100 blood slides a day, and in many instances this number was achieved. The units actually



Diagnosis Station Operating in Jordan Valley.
(Photo. by Col. Andrew Balfour: reproduced by kind permission of the *Lancet*.)

Diagnosis Station Operating at Tripoli in Syria, November, 1918.

also reported upon a large number of fæcal specimens, mainly for dysentery, about which, unfortunately, no adequate records now exist.

Rendering of Reports.—As regards the rendering of reports a period of five minutes was allocated for the microscopic examination of each slide. In order to avoid any unnecessary delay, and in order to ensure prompt delivery, the orderly who brought the specimens either from the regimental medical officer or from the field ambulance, was detained till the required number of examinations had been concluded, so that he could return with the reports. In most instances the orderlies themselves had been instructed in the methods of making blood films, and under the direction of medical officers were able to take them in a routine manner. On the whole this system was found to act admirably.

Training of Medical Officers and Men.—The successful performance of rapid and accurate microscopic diagnosis on a large scale, such as outlined above, entails a considerable knowledge of protozoology and cellular pathology. A course of instruction dealing especially with the diagnosis of malaria and dysentery was commenced in March, 1918, at a convenient centre some distance behind the line. Seven officers and sixteen Royal Army Medical Corps orderlies were detailed to attend this course, which lasted six weeks. Naturally, within this period, it was not possible to enter fully into a complete study of the blood nor to become familiar with all possible pathological appearances. It was shown, however, that within the time allocated it was possible to render the officers, and in most cases the men as well, familiar with the structure and appearances of the normal blood cells and the various stages of the malaria parasites, both in stained and unstained preparations. Separate classes were held for the officers and men.

The course was divided as follows :—

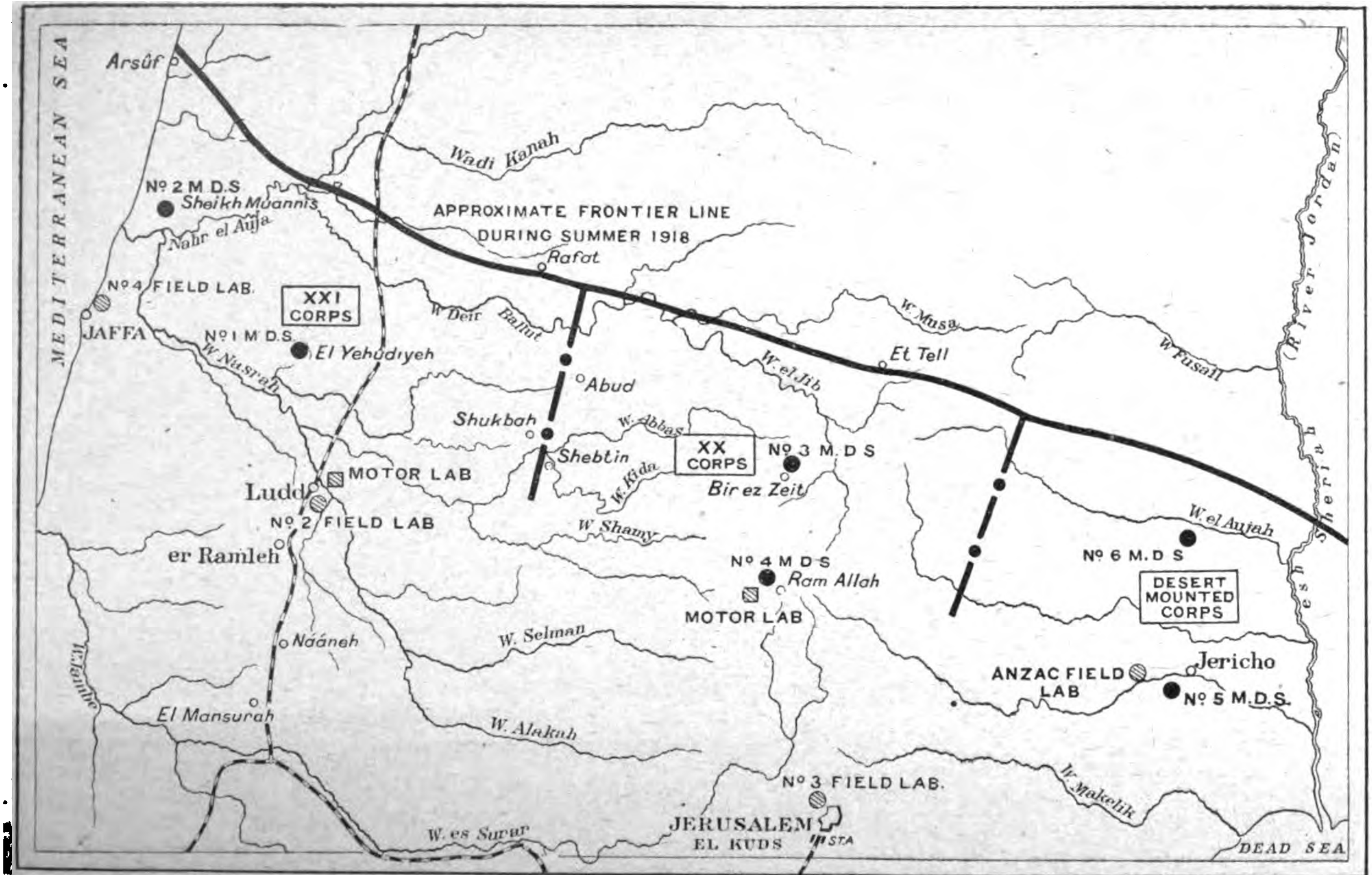
First week.—Study of normal blood of man, domestic animals, reptiles and birds.

Second week.—Study of pathological changes in the blood. Pernicious anæmia, changes in the blood cells produced by malaria, helminthic disease, etc.

Third and fourth weeks.—The recognition and detection of various forms of malarial parasites at different periods of development. Staining and recognition of spironemata of relapsing fever. The differentiation of these parasites from artefacts : Leishman's stain being utilized as a routine throughout.

Fifth week.—The recognition of Anopheline mosquitoes, their eggs and larvæ. A large amount of pathological material being available at that time, the last week of the course was devoted to a series of practical examinations in order to test their capacity to recognize blood parasites under the most severe conditions. When found proficient the class was moved to a field laboratory in connexion with a casualty clearing station, and their reliability was tested on the pathological material sent for examination.

MAP SHOWING DISPOSITION OF THE EGYPTIAN EXPEDITIONARY FORCE IN 1918.



Diagnosis Stations (M.D.S.) are shown by solid dots. Their relation to Field Laboratories before final advance is made clear. It is impossible to show in graphic form the route they took during the rapid advance into Syria. Field laboratories are indicated by a shaded dot. Motor laboratories are indicated by a shaded square.

At the end of two months the units were considered to be sufficiently efficient to be posted to their positions in the field.

In addition to blood work, in so far as opportunity offered, the officers were instructed in the practical diagnosis of dysentery. The main point to be arrived at is the recognition of the active stages of *E. histolytica*, and the features by which it may be differentiated from non-pathogenic species should be considered, rather than the different forms it may assume during various stages of its existence. It is the recognition of the active vegetative stage that is really essential. Little difficulty was experienced in teaching the cytological diagnosis of bacillary dysentery and especially the recognition of the large phagocytic cells which are apt to be mistaken for entamœbæ.

Should these diagnosis units be at any time employed in the future, great stress should be laid upon their aid in the rapid diagnosis of dysentery this being of equal importance as that of malaria.

It was laid down as a maxim that, though the orderlies were instructed in the use of the microscope, and in the appearance of parasites, yet the actual *diagnosis had to be made by the officer in charge.*

The position the diagnosis units occupied in the line during the summer of 1918 is shown in the accompanying map (see map, p. 420).

In the advance into Syria in September, 1918, the mobility of these units was amply demonstrated. The two diagnosis units attached to the Desert Mounted Corps were able to move forward with the cavalry. One was at work in Damascus by October 12, and soon became the laboratory centre for that city. The necessity of this diagnosis unit at that time, when malaria and influenza were both epidemic, may be gathered from the statement of the officer in charge. He stated that he found 11 out of 15 patients isolated as dysenterics to be suffering from subtertian malaria, and in the general ward of an improvised hospital he found 30 out of 45 patients, diagnosed on clinical grounds as influenza, to be examples of the same disease.

I may quote also from a report of the A.D.M.S of the Desert Mounted Corps: "In the recent operations microscopic examination of the blood proved to be of inestimable value. In every case of pyrexia the question immediately arose—is it malaria or influenza? If the former it was essential to give quinine at once, but, if this were done before a blood-slide could be taken, the probabilities were that the case would never be subsequently diagnosed and might be discharged without a proper course of treatment, as influenza. If influenza, it might go through a course of treatment for malaria on the presumption that quinine had obscured the parasite."

The actual amount of work performed by six diagnosis stations is given in the accompanying table.

As previously stated, it is not possible to give accurate statistics of the amount of dysentery diagnosis done during the same period, although this was by no means negligible.

THE ACTUAL AMOUNT OF WORK PERFORMED BY THE DIAGNOSIS STATIONS IN PALESTINE FROM APRIL TO OCTOBER, 1918 (SIX MONTHS).

No. of unit	Total slides examined	Benign tertian	Subtertian	Quartan	Mixed infection	Relapsing fever	Percentage of the main forms of malaria
1	16,002	2,550	823	3	123	194	15·9 per cent B.T. 5·9 ,, M.T.
2	8,432	3,292	366	—	—	72	39·0 ,, B.T. 4·3 ,, M.T.
3	3,414	856	69	—	—	60	25·0 ,, B.T. 2·0 ,, M.T.
4	5,595	745	507	2	--	35	13·3 ,, B.T. 9·0 ,, M.T.
5	4,121	546	675	4	3	—	13·2 ,, B.T. 16·4 ,, M.T.
6	2,604	494	174	—	—	—	18·9 ,, B.T. 6·6 ,, M.T.
Total ..	40,168	8,483	2,614	9	126	361	21·1 per cent. B.T. 6·5 ,, M.T.

THE FOLLOWING TABLE SHOWS THE NUMBER OF EXAMINATIONS MADE BY ALL SIX STATIONS, MONTH BY MONTH.

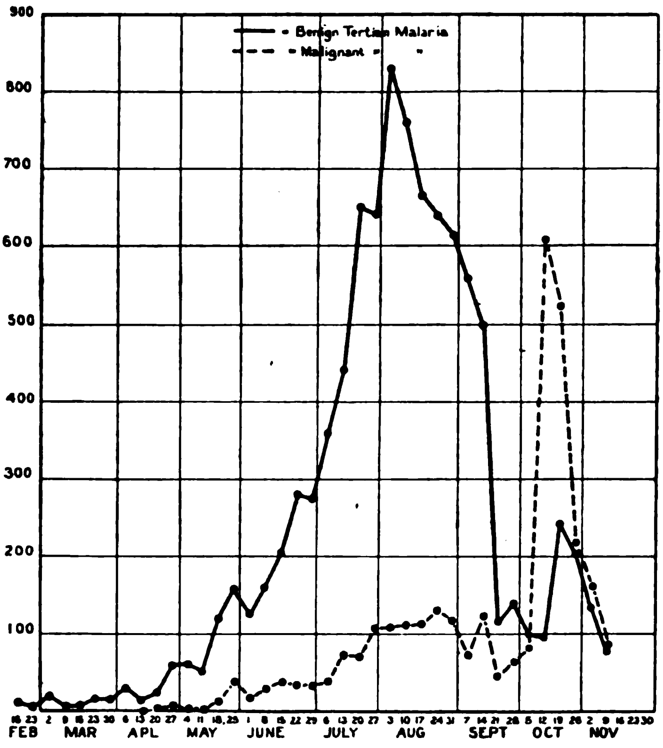
Month	Total slides	Benign tertian	Sub-tertian	Quartan	Mixed infection	Relapsing fever	Percentage of the main forms of malaria
April ..	189	28	4	—	—	8	14·8 per cent B.T. 2·1 ,, M.T.
May ..	2,781	588	95	2	1	122	21·1 ,, B.T. 3·4 ,, M.T.
June ..	6,415	1,303	225	—	4	161	20·3 ,, B.T. 3·5 ,, M.T.
July ..	7,243	2,019	203	3	5	29	27·8 ,, B.T. 2·8 ,, M.T.
August ..	12,724	3,074	567	—	41	23	24·1 ,, B.T. 4·4 ,, M.T.
September..	5,293	1,018	262	3	46	9	19·2 ,, B.T. 4·9 ,, M.T.
October ..	5,523	453	1,258	1	29	9	8·2 ,, B.T. 22·7 ,, M.T.
Total ..	40,168	8,483	2,614	9	126	361	21.1 per cent. B.T. 6·5 ,, M.T.

Together with the blood examinations done by the field laboratories attached to the force, the total number of slides examined amounted to 111,261 from which the accompanying graphs (Graphs I and II) were made. These demonstrate the prevalence of malaria during the various months, the earlier prevalence of the benign form and the dramatic and sudden autumnal rise of the subtertian infection.

THE VALUE OF THIS INFORMATION FROM THE POINT OF VIEW OF THE ADMINISTRATIVE STAFF.

The value of accurate statistical information of this kind, especially to the Sanitary Service, is obvious. The information with reference to the outbreaks of malaria and dysentery are so readily and promptly obtained, so as to enable active preventive measures to be as promptly taken whenever they occur.

GRAPH I.



Composite weekly malaria graph from aggregate returns of Diagnosis Stations, showing the infection of the Coastal Plain (Jaffa to Ludd, 1918); demonstrates the preliminary rise of benign tertian malaria.

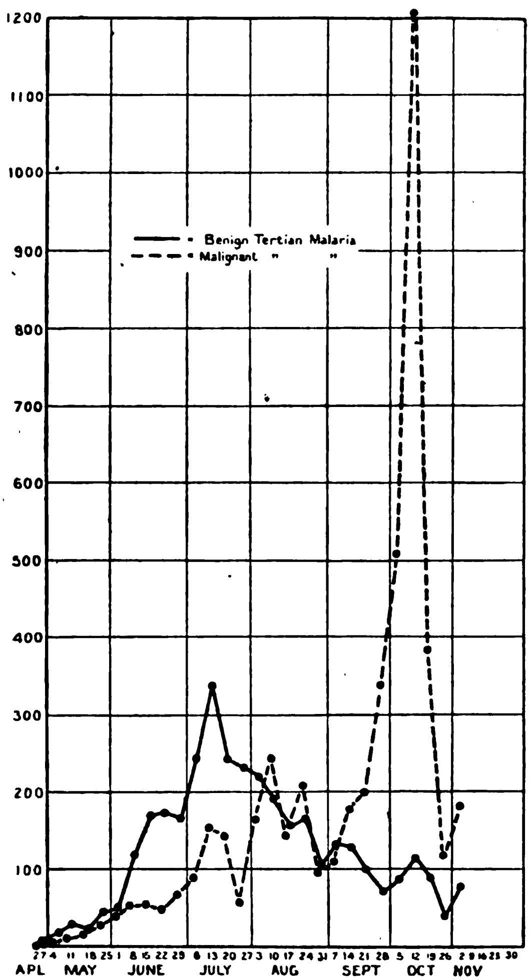
(Graphs I and II have been reproduced in a slightly different form in the *Lancet*, January 10, 1920.)

The nature of the information obtainable by these means is well illustrated by Graph III, which demonstrates, day by day, the incidence of malaria in the Cavalry Divisions operating in the direction of Damascus, and how the sudden rise of subtertian malaria took place after an incubation period of twelve days, subsequent to bivouacking one night in a malarial centre.

It appeared to be the fate of the cavalry to strike almost every possible

malarious locality. Night riding was almost the rule and infection was contracted at that time in the Plain of Esdraelon. It is estimated that at this time some 7,000 new infections occurred.

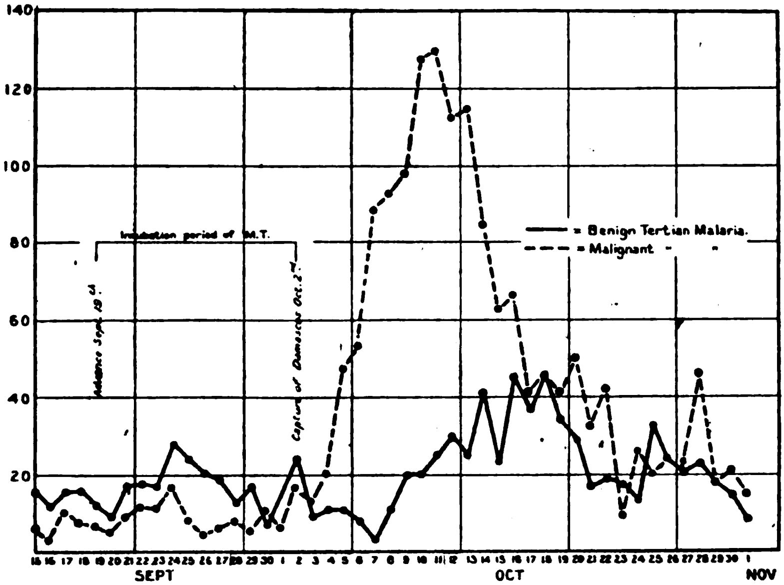
GRAPH II.



Composite weekly malaria graph from aggregate returns of the Diagnosis Stations, showing the infections of the Jordan Valley. The preliminary rise of benign tertian malaria and the rapidly developed autumnal epidemic of subtertian malaria are represented.

Although the main topic in this paper is malaria, the same information is readily obtainable, when desired, with reference to outbreaks of bacillary dysentery and enteric fever; it is especially valuable in localities infected with schistosomiasis.

GRAPH III.



Graph of subtertian malaria cases diagnosed by blood examination in September and October, 1918. Though representing but a fraction of the whole epidemic, it clearly shows the sudden onset after an incubation period of 12 days.

THE UNSUITABILITY OF MOTOR LABORATORIES FOR WORK OF THIS DESCRIPTION.

The advantages which mobile, horse-drawn, diagnosis units of this description possess over the cumbrous, more elaborate motor laboratories in a semi-civilized country with bad and in many cases non-existent roads, soon became apparent. As has already been stated these horse-drawn vehicles could proceed over the roughest ground, the equipment being light, the glass ware being minimal, and the whole outfit of the simplest character. The motor laboratories, on the other hand, though capable of doing very excellent work where the roads were reasonably passable, proved to be too heavy and cumbersome to move over rough country, and in doing so the vibration caused great disorganization of the delicate apparatus, and damage to the glassware. And after the rains or in sandy desert they were unable to move at all. The somewhat elaborate equipment proved for rough work of this description to be disadvantageous, for, indeed, the simpler the apparatus the more rapidly is the work performed.

For work of this description the diagnosis station is more economic, more practical, and is therefore preferable to the motor laboratory.

ADMINISTRATION OF DIAGNOSIS UNITS.

The map (p. 420) shows the disposition of these units in Palestine during the summer of 1918, immediately before the September advance. They were

allocated two to each Corps, but since they had proved their usefulness and practicability, and since it was realized that they did not hinder, but rather accelerated the evacuation of the sick, I consider that this number could be advantageously increased to three in each Corps, so as to be accessible to every field ambulance.

As regards their position in the field, I am of the opinion that they should be attached for rations to the most forwardly situated field ambulance, but this naturally is a matter for discretion as circumstances arise.

In the matter of command, it was found advantageous for purposes of co-ordination to keep these units under the administration of one officer who was responsible for their work and the provision of the necessary reagents and supplies. It is suggested that this officer, who may be termed "officer in charge of diagnosis units," should himself be responsible to the director of pathology attached to the Force. Probably, unity of purpose is better obtained if the work and allocation of these units is made from general headquarters.

SUPPLY.

The officer in charge of these units should be responsible for the regular supply of necessities. Such necessities include microscope slides, cover slips, fully prepared and active Leishman's stain, freshly prepared *neutral* distilled water; this latter is most important. These supplies were obtained from the nearest field laboratories, special attention being given to the question of the stain and the distilled water; the condensation water from the steam sterilizers provided in these laboratories being found suitable for the latter purpose. The water was despatched to the diagnosis units in gallon rum jars whenever transport was available.

THE RELATION OF THE DIAGNOSIS UNIT TO THE EVACUATION OF THE SICK.

So far from impeding the evacuation of the sick from the forward area, it is evident from the foregoing, that, by establishing a rapid diagnosis, the mechanism of evacuation is accelerated. The work of the field laboratories is also greatly alleviated and the routine of the casualty clearing station considerably lightened. In times of emergency it is necessary, as in 1918, to conserve the man-power; here the work of the diagnosis unit becomes invaluable. By differentiating the more serious from the less severe forms of disease, it is possible to reduce the sick rate, by returning those only temporarily indisposed directly to their units, so as to avoid their evacuation altogether. For this purpose accurate diagnosis is essential, especially the differentiation of subtertian from tertian malaria.

THE FIELD LABORATORIES.

These are larger and more complicated units, and are necessarily more heavily equipped and less easily mobile, and therefore can usually be estab-

ished only where rail and road transport is available. They should be capable of performing more elaborate bacteriological work and the routine analysis of the water supplies. Their work is of a more general character, and their situation in the field should be in relation to a casualty clearing station or a group of these units. In many ways they should supplement and elaborate the work already performed by the diagnosis stations. I therefore give an outline of the establishment and equipment we found to be necessary, as the result of experience in such a field laboratory four of which were attached to the Egyptian Expeditionary Force.

Equipment of a Field Laboratory.

The equipment of a typical field laboratory such as that referred to may be stated as follows :—

Two Indian Pattern Marquees, one for the accommodation of the officer in charge, the other for use as a laboratory; one portable canvas hut, in sections, easily dismantled and erected, windows of mica, wooden floor. Dimensions: 16 feet by 8 feet by 8 feet.

In the hut, media making and preparation generally is carried out: it also serves as a store-room for reagents and glassware.

One bell tent for accommodation of the Royal Army Medical Corps orderlies.

Apparatus.

One Autoclave.—This is the only piece of apparatus really necessary in the field for making culture media, sterilizing glassware, etc. It can also be employed as a steamer, and, with care, it is possible to inspissate blood serum in it.

A hot-air oven and steamer are quite unnecessary.

One Incubator.—Hearson's A.1 model working at 37° C., and heated by a paraffin lamp is the best type. It is difficult to know where to place the incubator for safety. The most convenient position is undoubtedly in the laboratory marquee as this obviates running to and fro with cultures. One field laboratory was burned down through something going wrong with the incubator lamp, which set fire to the marquee. We never had any difficulty in this direction except in the rough weather when the lamp used to blow out. Perhaps the canvas hut is the safest, if the least convenient, place in which to keep the incubator; it is much less draughty than the marquee.

Four six-feet Folding Tables.—Two of these are required for the laboratory marquee, one for the canvas hut and one for the officer's tent.

Six Folding Canvas Stools.—These are much more convenient than wooden forms.

Four Primus Stoves burning Paraffin Oil.—Two stoves, each having four burners, are required for purposes such as heating the autoclave. Two one-burner stoves are required for operations such as boiling water for

washing glassware, etc. The nipple burners on these stoves frequently become choked with a deposit of carbon, when they are useless for heating purposes. Special needles are made for removing this carbon and a good supply of these should be obtained. A good stock of new nipple burners together with a special key for unscrewing old and fitting new ones, should be carried in the equipment.

Two Bunsen burners for burning methylated spirit; the burner is attached by means of rubber-tubing to a reservoir containing spirit. These burners are useful in the laboratory marquee; they can be employed for heating the water in sterilizing, baths, etc. If the field laboratory is stationed on the sand, it is important to have the floor of the marquee in which cultural operations are carried out covered with a tarpaulin sheet; this prevents fine sand from blowing about and the floor is easily swept. The door flaps of the marquee ought to be closed each night in case of storm, otherwise sand is blown into everything in the laboratory.

One sweeping brush.

In the following list of glassware and reagents, quantities are not stated as these will mainly be determined by distance of the laboratory from the base medical stores.

Glassware.

2-litre flasks.
1-litre flasks.
½-litre flasks.
250 c.c. flasks.
100 c.c. flasks.
50 c.c. flasks.
Test tubes.
Durham's tubes for fermentation tests (these can be made from narrow glass tubing).
Petri dishes, large and small.
Microscope slides.
Well slides.
Cover slips.
Measuring cylinders, 1,000 c.c., 100 c.c., 25 c.c.
Pipettes of various capacities.
Burettes and stands for same.
Porcelain dishes.
Beakers—various sizes.
Dropping bottles for stains.
Funnels.
Glass tubing.
Watch glasses.
Bottles with ground glass stoppers.
Spirit lamps.
Specimen tubes for fæces, etc.
Hypodermic syringes of various capacities.

Apparatus and Reagents.

Microscopes fitted with $\frac{2}{3}$-, $\frac{1}{6}$-, $\frac{1}{12}$-inch objectives.
Balance and weights.
Red and white blood cell counting apparatus.
Hæmoglobinometer.
Lamps—hurricane pattern—excellent for microscope illumination.
Hand centrifuge.
Files, triangular in section.
Filter papers.
Indiarubber tubing.
Tripods.
Wire gauze for tripods.
Test tube stands.
Wire baskets for incubator.
Test tube brushes.
Pestle and mortar.

Rubber gloves.
P.M. instruments.
Hammer and pincers.
Scalpels.
Forceps.
Scissors.
Grease pencils.
Platinum wire.
Iron wire for making throat swabs.
Urine testing set.
Thresh water testing set.
Ice chest for storage of sera, etc.
Sterilizing baths.
Hydrochloric acid.
Nitric acid.
Sulphuric acid.
Acetic acid.
Formalin.
Absolute alcohol.
Methyl alcohol.
Methylated spirit.
Xylol.
Ether.
Agar agar.
Peptone (sugar free).
Sodium chloride.
Lemco.
Cresol.
Soap.
Plasticine.
High titre sera.
Indol reagent.
Diluting fluids for blood counts.
Aniline oil.
Glucose.
Lactose.
Saccharose.
Dulcite.
Mannite.
Mercuric chloride.
Iron alum.
Iodine.
Potassium iodide.
Sodium citrate.
Copper sulphate.
Caustic soda.
Rochelle salt.
Cedar wood oil.
Vaseline.
Mead's strapping.
Corks.
Rubber stoppers.
Litmus papers, red and blue.
Lint, non-medicated.
Cotton wool.
Gauze.
Rubber teats.
Fehling's solution, Nos. 1 and 2.

Stains.

Leishman.
Neutral red.
Methylene blue.
Bismarck brown.
Eosine.
Hæmatoxylin.
Methyl violet.
Carbol fuchsin.

The above list does not pretend to be exhaustive; for, as already indicated, the stock of materials carried will depend upon the distance from the base.

In place of special wire baskets for holding culture tubes, old cigarette tins (the round variety) with a layer of cotton wool at the bottom can be substituted.

Good staining troughs can be made by laying two pieces of solid glass rod across the length of a flat tin and holding them in position by means of plasticine. Tins of this description can usually be obtained from the canteen.

Distilled Water.—This can be made in a field laboratory in the follow-

ing manner: A goo supply of water is placed into the autoclave, the inside of which is *kept clean.* The lid of the autoclave is placed in position and the valve is opened. The water is brought to the boil and when steam issues from the valve the latter is connected to a worm condenser. The water used for condensing the steam is syphoned from a kerosene tin to the worm from which it runs into another tin. This water can be used time after time—a great consideration under desert conditions. The distilled water issuing from the worm is collected in a clean vessel.

All packing cases and lids should be carefully preserved ready for the next move. The cases can be arranged around the marquee and hut where they serve as cupboards. Straw from the packing cases should also be kept, it can be buried in the sand until required.

A field laboratory as described above will fit, when packed, in a ten-ton railway wagon. Laboratories of this type are also very mobile; they can be packed, moved and set up in a fresh place in a short time and can if necessary be transported in G.S. wagons. They are better in a country like Palestine than the laboratories fitted on motor lorries.

It is an advantage to pitch the laboratory fairly close to the casualty clearing station or field hospital to which it is attached. This prevents delay in getting specimens to the laboratory, e.g., dysentery stools, blood films, etc. Also, it enables the officer in charge of the laboratory to see the patients in the wards himself.

Personnel of Field Laboratory.—One officer, who is generally a bacteriological pathological specialist.

Three Royal Army Medica Corps Orderlies.—One orderly assists the officer in charge in the laboratory, another prepares the culture media, etc., while the third acts as clerk. The last named keeps a careful record of the results of tests made in the laboratory. One batman.

The large amount of work such a field laboratory, equipped and staffed as above, may be called upon to do in war time, even when a large amount of primary diagnosis work has already been performed by the diagnosis stations, may be gathered from the subjoined returns of such a field laboratory in 1918.

The object of this somewhat lengthy paper I submit will have been attained if it is possible to establish the value of rapid scientific diagnosis as a branch of Army medical organization in war-time.

That the work can be adequately and satisfactorily performed without clogging the essential existing machinery of evacuation has, I hope, been amply demonstrated. From these recorded facts the principle emerges that for the satisfactory administration of the medical services in a tropical or sub-tropical country, the microscope is as essential for diagnosis and treatment as is the provision of surgical apparatus.

In conclusion I have to thank those who have assisted me in preparation of this paper, as well as in the working of the scheme I have elaborated.

These are too numerous to mention, nevertheless my gratitude is none the less sincere. My thanks are specially due to Drs. C. M. Craig, John Anderson, E. C. Myott, and my former assistant, Mr. T. R. Goddard.

TABLE SHOWING THE NUMBER OF EXAMINATIONS MADE IN A FIELD LABORATORY BETWEEN JANUARY 1, 1918, TO DECEMBER 31, 1918. (CAPT. COLIN M. CRAIG, O.B.E.)

Total of diarrhœa cases examined		6,418
Bacillary dysentery actually diagnosed		75
B. shiga isolated	58	
B. flexner isolated	17	
Bacillary dysentery, "provisional diagnosis"		1,920
Amœbic dysentery		150
Flagellate diarrhœa		171
Malarial "dysentery"		3
Enterica stools plated		28
Enterica stools positive		1
Total of other examinations		53,245
Throat swabs for diphtheria bacillus		2,776
K.L.B. isolated	294	
Septic sores for diphtheria bacillus		50
K.L.B. isolated	13	
Blood films examined		48,124
Malignant tertian parasites found	2,442	
Benign tertian parasites found	3,792	
Quartan parasites found	3	
Relapsing fever	2,095	
Urine—general examination		268
Urine for typhoid		3
Sputa for T.B.		242
T.B. found	15	
Sputa for organisms		262
Blood for culture		14
Blood for typhus (Weil-Felix reaction)		375
Positive Weil-Felix	64	
Blood for Widal's reaction		958
Typhoid	19	
Para A	13	
Para B	6	
Conjunctivitis		7
Cerebrospinal meningitis		7
Meningococcus isolated	2	
Pus for anthrax		10
Anthrax bacillus found	4	
Pus films for organisms		117
Fluid from joints		10
Fluid from gun-shot wounds		3
Pleural effusion		15
Blood (hæmoptysis)		1
Blood for *M. melitensis*		1
Fluid from oriental sore for Leishman-Donovan bodies		1

Microscopical examinations	=	59,663
Post mortems	=	147
Veterinary work	=	30
Shaving brushes for anthrax	=	8
Total		59,848

ELABORATION OF A METHOD SUITABLE FOR CONDUCTING COMPLEMENT FIXATION TESTS IN GONORRHŒA.

A REPORT TO THE MEDICAL RESEARCH COUNCIL.

By W. J. TULLOCH, M.D.

(From the Department of Bacteriology, University College, Dundee, The University of St. Andrews.)

(Continued from p. 348.)

Preparation of Antigens by Alternate Freezing and Thawing.

A technique based on freezing suspensions with liquid air and thawing by warm water, so that a volume of ten cubic centimetres could be frozen and thawed twenty to twenty-five times in an hour and a half, has been in use in this laboratory for the last three months; it is practically the same method as that described by C. C. Melick (*Journ. Med. Res.*, xliii, January-October, 1922, p. 405). This author reports favourably upon antigens of the colon-typhoid group thus prepared, and states that after such treatment, by centrifugalization at high speed he can separate the suspension into a clear supernatant fluid of high antigenic value with negligible non-specific anticomplementary qualities, and a deposit of the bodies of the organisms of less marked value as antigens, and with a considerable degree of non-specific anticomplementary action.

In the case of the gonococcus treated thus I have not been able to show this separation in the way in which Melick describes in his work on the colon-typhoid group, but it has been my experience that antigens of gonococci prepared by this method have proved extremely valuable.

The method which I have used is essentially the same as that described by Melick: Young cultures of the gonococcus are washed off with saline, one cubic centimetre being used to remove a confluent growth from the surface of a 6 by ¾ agar slope. About ten tubes are dealt with at one time, and the thick suspension—volume about ten cubic centimetres of cocci so obtained is transferred to a thin-walled glass tube of size 6 by ¾. The tube containing the suspension is lowered by means of a cotton string into a Dewar flask containing liquid air, and remains there for one minute fifteen seconds, by which time the contents of the tube are frozen hard. It is then removed and plunged into a water-bath at 80° C., being shaken all the time that it remains in this, so that the temperature in the tube is equalized, and never at any point rises above 20° C. Whenever thawing is complete, the outside of the tube is dried and the tube returned to the liquid air. This process of freezing and thawing is repeated twenty to twenty-five times, after which the suspension is transferred to centrifuge

tubes and centrifuged for one hour at 3,000 r.p.m. Thereby the solid constituents are spun out and an almost water-clear supernatant fluid results; this is used as the antigen, being pipetted off and stored in ampules frozen until it is required. In the tests it is employed diluted 1 in 15 with saline.

For purposes of investigation the deposit obtained on centrifugalizing the suspension was resuspended in the original volume of saline, so that the anticomplementary and antigenic qualities of the supernatant fluid and those of the resuspended deposit could be compared and contrasted.

With the "supernatant" antigen and the "resuspended" antigen so obtained, the following experiments were carried out:—

Experiment 1.—To compare the anticomplementary qualities of these two antigens.

Guinea-pig complement diluted 1 in 5 after absorption with sheep cells was distributed in 0·5 cubic centimetre quantities into each tube of two series of seven tubes. To the first series of seven tubes was added varying quantities of "supernatant" antigen. This was added undiluted, and corresponded in strength to the extract from a suspension containing approximately 15,000 million cocci per cubic centimetre. To the second series was added corresponding quantities of "resuspended" antigen, and in both series the volume was made up to one cubic centimetre with saline. The tubes were incubated for two hours at 37° C., and thereafter 0·5 cubic centimetre of 2½ per cent suspension of sheep cells sensitized with 2 m.h.d. of antisheep corpuscle serum was added to each and incubation continued at 37° C. in a water bath for thirty minutes.

	Undiluted antigens						
	0·01	0·02	0·03	0·04	0·075	0·1	0·2
"Supernatant" antigen ..	+	+	+	+	+	+	+
"Resuspended" antigen ..	+	+	+	+	+	+	+

+ means complete lysis.

Within the limits of the experiment, then, neither of these exhibited anticomplementary properties.

Experiment 2.—The deviating properties of each was now tested:—

(1) Varying quantities of each antigen were distributed into four series of five tubes, two series being for the "supernatant" antigen and two for the "resuspended" antigen.

(2) To each tube of one series containing "supernatant" antigen was added 0·05 cubic centimetre of 1 in 5 dilution of antigonococcus (rabbit) serum and to each of the other series containing the same antigen was added one cubic centimetre of inactivated and undiluted rabbit serum.

(3) The same was repeated in the two series containing "resuspended" antigen.

(4) Guinea-pig complement, previously absorbed with sheep cells, and 1 in 20 was added to each tube in a volume of 0·5 cubic centimetre.

(5) All four series were incubated at 37° C. in the incubator for two hours.

(6) There was then added 0·5 cubic centimetre of 2½ per cent suspension of sheep cells sensitized with 2 m.h.d. of antisheep corpuscle serum and incubation in a water bath continued for sixty minutes at 37° C.

The following results were obtained:—

	Supernatant antigen					Control antigen alone	Control serum alone
	0·0125	0·025	0·05	0·1	0·2	0·2	0·2 of 1 in 5 antigonococcus
Antigonococcus serum, 0·05 of 1 in 5	—	—	—	—	—	+	+
Normal serum, 0·1 undiluted	+	+	+	+	+		

	Resuspended antigen					Control serum alone
	0·0125	0·025	0·05	0·1	0·2	0·2 c.c. of normal
Antigonococcus serum, 0·5 of 1 in 5	P	—	—	—	—	
Normal serum, 0·1 undiluted	+	+	+	+	+	+

\+ means complete lysis. P means partial lysis.
— means no lysis.

These two experiments show:—

(1) That the supernatant antigen has in the presence of 0·1 cubic centimetre of normal rabbit serum no deviating quality, even when present in the amount of 0·2 cubic centimetre, while

(2) In presence of antigonococcus serum so diluted that the quantity present in the tests was 0·0125 cubic centimetre, this antigen gave complete fixation, the other conditions of the experiment being the same. The ratio of its fixation value to its anticomplementary action is, therefore, greater than sixteen to one.

(3) The resuspended antigen also shows good deviating qualities but the occurrence of some lysis in the tube containing 0·0125 cubic centimetre of the antigen suggests that its ratio of deviation to anticomplementary quality is not perhaps quite so good as that of the supernatant antigen. This fixation experiment was repeated using a complement which had proved to be exceptionally active in hæmolysis. The technique here used was the same as before but the range of dilutions of antigen was greatly extended, the object being to determine an end point.

	Antigen					
	0·0025	0·005	0·01	0·015	0·02	0·025
Supernatant antigen ..	+	+	+	+	—	—
Resuspended antigen ..	+	+	+	+	P	—

\+ means complete lysis. P means partial lysis.
— means no lysis.

From this it may be concluded that there is but little to choose between the supernatant and resuspended antigens.

This is important for it suggests that under certain conditions a simple saline suspension of the gonococcus might be used as antigen instead of the product prepared by alternate freezing and thawing. Were such the case it would greatly enhance the value of the test, for the cost and labour of preparing antigens by the liquid air method precludes their use upon a

large scale. Moreover, relatively few laboratories are able to obtain the necessary supplies of this reagent for their preparation.

(*E*) *Antigens Prepared by the Besredka Method and Antigens consisting of Simple Suspensions of the Gonococcus.*—Notwithstanding the many methods that have been described for preparing gonococcus antigens, Kolmer ("A Practical Textbook of Infection, Immunity and Specific Therapy," Saunders and Co., 1920, p. 506), states that "After an experimental study of various antigens it was found that a simple suspension of gonococci in saline gave slightly better results."

It, therefore, appeared probable that some method could be elaborated for preparing simple suspensions that could be satisfactorily employed as antigens in the test under consideration.

With this object in view the following experiments were carried out :—

An antigen was prepared thus after the method of Besredka : A strain of Type I gonococcus was cultivated for forty-eight hours on agar (a special agar to be described later was used) was scraped off and put into alcohol. The alcohol was pipetted off and the material dried in an oven at 56° C. This dried material was weighed and to it was added a weighed quantity of pure NaCl. This mixture was now triturated in an optically ground glass mortar and suspended in distilled water sufficient to make the concentration of NaCl in the final product equal to 0·9 per cent solution. This was then standardized and diluted to a strength corresponding to the suspensions employed for making the liquid air antigens.

At the same time both supernatant and resuspended antigens, as described before, were prepared from the same strain.

These three antigens were now tested for anticomplementary action, and for deviating quality.

Test of anticomplementary action :—

(1) All three antigens were diluted with saline to give a concentration corresponding to 1,000 million cocci per cubic centimetre. Each was distributed in varying but comparable quantities in each of three series of tubes. The volume was made up in each tube to 0·5 cubic centimetre.

(2) Guinea-pig complement absorbed with sheep cells and diluted to 1 in 20 was added to all the tubes in a volume of 0·5 cubic centimetre.

(3) The mixtures were incubated for two hours at 37° C.

(4) Thereupon 0·5 cubic centimetre of a 2½ per cent suspension of sheep cells, sensitized with 2 m.h.d. of antisheep corpuscle serum, was added to each tube, and incubation continued for thirty minutes at 37° C. in a water bath.

	Antigen									
	0·005	0·01	0·015	0·02	0·025	0·03	0·035	0·04	0·045	0·5
Antigen prepared by grinding in salt	+	+	+	+	+	+	+	+	P	—
Supernatant antigen	+	+	+	+	+	+	+	+	+	+
Resuspended antigen	+	+	+	+	+	+	+	+	+	+

+ means complete lysis. P means partial lysis.

This experiment shows that the antigen prepared by the Besredka method is more anticomplementary than the other two, but unfortunately

the series of tests was not sufficiently extended to indicate the comparative degree of this quality.

As, however, the sole object of the experiment was to compare the antigens under consideration from the standpoint of their specific deviating qualities a fixation test was set up using all three.

(1) The antigens were varied in concentration, the maximum concentration examined corresponding to half the anticomplementary unit of the most anticomplementary of those tested—the Besredka antigen. The volume was made up to 0·5 cubic centimetre.

(2) Type I antigonococcus (rabbit) serum diluted 1 in 5 was added to each tube in the volume of 0·05 cubic centimetre.

(3) Guinea-pig complement, 0·5 cubic centimetre of 1 in 20 dilution was added to each. This reagent was absorbed with sheep cells before being used.

(4) Incubation was for two hours in an oven at 37° C.

(5) Whereupon 0·5 cubic centimetre of 2½ per cent suspension of sheep cells sensitized with 2 m.h.d. of antisheep corpuscle serum was added, and

(6) Incubation continued in water bath for thirty minutes at 37° C.

	Antigen									
	0·0025	0·005	0·0075	0·01	0·0125	0·015	0·0175	0·02	0·0225	0·025
Antigen prepared by grinding in salt	+	+	+	+	+	+	+	+	+	−
Supernatant antigen	+	+	+	+	+	+	ACL	−	−	−
Resuspended antigen	+	+	+	+	+	+	+	P	P	−

+ means complete lysis. P means partial lysis.
ACL means almost complete lysis. − means no lysis.

There is, therefore, a better ratio between the fixation quality and the anticomplementary quality in the case of the supernatant and resuspended antigens than in that of the antigen prepared by grinding in salt.

At first sight it appeared that no explanation of this could be offered but the culture used for preparing the liquid air antigens had only been grown for fourteen hours, while that used for making the Besredka antigen had been grown for forty-eight hours. It seemed possible then that the anticomplementary quality developed as the growths aged, and this led to the use of simple saline suspensions of very young cultures as antigens.

Preliminary investigations indicated that there was some reason to regard ageing as the explanation of the development of anticomplementary activity, but it was found that while some strains markedly developed such quality others exhibited it only in slight degree. This finding is in complete agreement with those of C. Thomson and E. Vollmond (*Acta Med. Scandinav.*, 1922, vol. lvii, No. 1), who, moreover, associate this development of anticomplementary action in high degree with a particular serological sub-group of the gonococcus.

By the following technique good growths of the gonococcus can be obtained after six hours' culture, and so far it has been my experience that

suspensions of certain strains when thus cultivated are, for practical purposes, devoid of anticomplementary qualities.

Stock cultures of the strain or strains to be used are maintained by weekly culture in Torrey's (*Journ. Inf. Dis.*, xxxi, No. 2, August, 1922, p. 125) semi-solid agar slightly modified to suit the conditions of this laboratory.

Semi-solid agar is prepared as follows: 500 grammes of fresh chopped ox heart free from fat, two whole *fresh* eggs and one litre of water are placed in a double-sided saucepan over a free flame, stirring constantly, till a temperature of 60° C. is reached. The material is maintained at this temperature for five minutes when ten grammes of Difco peptone and ten grammes of agar are added, and the temperature raised slowly until the medium assumes a brownish colour. It is now made slightly alkaline to litmus by the addition of ten per cent Na_2CO_3 and is transferred to a coffee-pot which is placed in the steamer for forty-five minutes. The coagulable protein forms a clot, this is carefully separated from the sides of the vessel which is then returned to the steamer for thirty minutes. Filtration is done by passing the material first through a fine-mesh metal strainer—a coffee-strainer is suitable—and then through a plug of glass wool lightly packed in the stem of a filter funnel. One should not aim at obtaining a perfectly clear product as this is liable to entail unnecessary exposure to heat, which is to be avoided. The reaction is brought to PH 6·8 using brom-thymol-blue as an indicator. The material is then either tubed directly or stored in small quantities—not more than 200 cubic centimetres —so that when melted for distribution the whole contents of one receptacle can be dealt with at one time. All glass ware employed in making and distributing the medium should be sterilized before use, so that final sterilization need only be steaming once for fifteen minutes.

For use the medium is tubed in five-cubic-centimetre quantities in 6-inch by ½-inch tubes, sterilized for fifteen minutes at 100° C. in the steamer, and cooled to 56° C., when one cubic centimetre of 1 in 5 sterile rabbit plasma is added.

For stock purposes this medium is especially valuable as most strains of the gonococcus remain viable on it for about three weeks if kept at 37° C., while it also occupies an important place in primary culture of the micro-organism, especially when cultures are being made from cases of acute urethritis and contamination with secondary invaders has not occurred. Direct inoculation of this medium with material from such cases gives excellent growths from which isolations can be made later.

A medium made in a similar way is suitable for preparing surface growths. This medium differs from the previous one only in that it contains fifteen to eighteen grammes of agar instead of ten grammes, and is standardized to PH 7·4 instead of PH 6·8, the indicator used being either phenol red or a-naphtholphthalein. It is enriched with rabbit plasma before use in the same way as the previous medium, and if a drop of fresh

human blood be also added it constitutes an excellent medium for primary isolations.

The antigen is prepared thus:—

From stock cultures on the semi-solid agar one inoculates slope tubes of the solid agar, size 6 inches by ¾ inch; these tubes should be heated to 37° C. before inoculation. The cultures are incubated overnight and usually a confluent growth is obtained the following morning. From this rapidly growing culture three tubes of the same medium, heated to 37° C. before use, are seeded and forthwith incubated. If the medium has been correctly prepared and used with the precautions mentioned, a confluent growth is obtained in six hours. This growth is scraped off and suspended in saline—one cubic centimetre of saline per tube of growth is a suitable amount—and is stored in the ice-chest overnight, to be used as antigen the following morning. For use in the tests it is diluted to contain 1,000 million cocci per cubic centimetre, at which concentration it should exhibit no anticomplementary qualities.

Unfortunately, antigens prepared from some strains of the coccus, even when grown under these conditions, do exert anticomplementary action and cannot be used, as is shown by the following experiment:—

Two strains of the gonococcus, 6439 and 6495, were cultivated and suspensions made therefrom as above. These were distributed into two series of eight tubes in the quantity of 0·25 cubic centimetre per tube. Guinea-pig complement diluted 1 in 24 after absorption with sheep red cells was added in varying quantity as shown in the following table, the volume being made up with saline to 0·5 cubic centimetre in each tube. At the same time an antigen prepared by the "liquid air method" correspondingly diluted was also tested along with a control containing no antigen.

Preliminary incubation was for two hours at 37° C. and thereafter 0·25 cubic centimetre of 2½ per cent suspension of sheep cells, sensitized with 2 m.h.d. of antisheep corpuscle serum was added, and the whole incubated in a water bath at 37° C. for a further thirty minutes.

	Complement 1/24							
	0·075	0·1	0·125	0·15	0·175	0·2	0·225	0·25
6439, 6 hours' antigen, 1,000 mill.	—	—	—	P	P	ACL	+	+
6439, liquid air antigen	—	—	—	T	P	ACL	+	+
6495, 6 hours' antigen	—	—	—	—	—	—	T	P
No antigen	—	—	—	P	P	ACL	+	+

— means no lysis. T means trace lysis. P means partial lysis.
ACL means almost complete lysis. + means complete lysis.

It is seen, then, that *provided a suitable strain is selected*, it need hardly be pointed out that in the present state of knowledge it is advisable that this strain be a representative of the predominant serological type—a simple six-hour suspension can be prepared, which, used in adequate concentration for fixation tests, does not exhibit any anticomplementary quality.

Up to the time of writing seventy tests have been made in duplicate using both "six-hour" and "liquid air" antigens in presence of human

serum from a variety of conditions, and in this series it has been found that identical results have been obtained with both antigens in sixty-three instances. In five cases the results were discrepant in that there was fixation with one antigen and not with the other, four showing a greater delicacy on the part of the liquid air antigen and one on the part of the six-hour antigen, but it should be noted that the four former all occurred on one day, when the six-hour antigen had to be unduly diluted because of its showing anticomplementary activity—it contained for experimental purposes equal parts of 6439 and 6495 suspensions. It may be noted, too, that in all five cases there was definite evidence of gonococcal infection from microscopical examination of discharges. The remaining two discrepancies were of such slight degree as to be scarcely worthy of note; in the first of these, the one antigen, and in the other the second antigen, appeared to be more delicate.

IV.—Technique decided upon for a Preliminary Series of Tests with Human Serum from 100 Cases of all Kinds attending a Venereal Diseases Clinic.

The following technique was decided upon for making a series of preliminary tests with clinical material in order to determine the value of the method:—

(1) When the specimens of blood arrive at the laboratory they are centrifuged to separate the serum. The serum is then inactivated at 56° C. for fifteen minutes and is stored in the ice-chest until the evening before the test is to be carried out.

(2) On the evening before the test, add to each cubic centimetre of inactivated serum 0·1 cubic centimetre of centrifuged deposit of washed sheep cells.

(3) Also on the evening before the test bleed out at least three guinea-pigs to obtain complement. (In this laboratory it is the custom to use such pooled guinea-pig serum for Wassermann tests, and by doing the gonococcus complement fixation reaction on the same day, or on the day following, as that set aside for Wassermann reactions, expense is lessened.) The required amount of guinea-pig serum is absorbed with sheep cells by adding 0·1 cubic centimetre of washed red cell "cream" to each cubic centimetre of complement. The tube is gently agitated and is stored in the ice-chest overnight.

(4) On the morning of the test prepare the following:—

(*a*) Washed sheep cells as for the Wassermann test, but make up to a 2½ per cent suspension instead of a 5 per cent suspension. This suspension is sensitized with 2·5 m.h.d. of antisheep corpuscle serum, the m.h.d. of this reagent having been determined by the method used for its titration in the Fildes-McIntosh technique of conducting the Wassermann test. The sensitization of the sheep cells is the first thing that should be done on the morning of the test.

(*b*) Centrifuge the complement to spin out the absorbing red cells, and taking 0·2 cubic centimetre of this, dilute it 1 in 24 with freshly prepared saline.

Using this diluted complement, a preliminary test is thus set up: two rows of eight tubes are set up in one rack, containing the following reagents:—

	1	2	3	4	5	6	7	8
Complement, 1/24 ..	0·75	0·1	0·125	0·15	0·175	0·02	0·225	0·25
Saline	0·175	0·15	0·125	0·1	0·075	0·05	0·025	Nil
Front row—saline ..	0·25	0·25	0·25	0·25	0·25	0·25	0·25	0·25
Back row—antigen .	0·25	0·25	0·25	0·25	0·25	0·25	0·25	0·25

The antigen used was that described herein as the "supernatant liquid air" antigen diluted so that it represented the extracted material from a suspension of cocci containing 1,000 million micro-organisms per cubic centimetre.

The tubes are incubated at 37° C. in the dry incubator for two hours and thereafter 0·25 cubic centimetre of the 2½ per cent sensitized sheep cells is added and incubation at 37° C. now in the water-bath is continued for thirty minutes, when a final reading of this preliminary test is made. If complement and antigen are suitable for the test, the tube showing complete lysis in the back row should correspond to that showing complete lysis in the front row, showing that the antigen has itself no anticomplementary activity, or alternatively that the complement is not exhibiting non-specific deviation in presence of the antigen. It should be noted that so far the most clear-cut results have been obtained with complements showing in the preliminary tests complete lysis in tubes 2, 3 or 4. When the complement is so inactive that lysis occurs only in tubes 5, 6, 7 or 8 the interpretation of the tests presents greater difficulty. So far I have not encountered a complement giving complete lysis in tube 1.

(5) During the time that incubation of the preliminary tests is proceeding one sets up the tubes for the tests proper.

(*a*) The sera to be tested are centrifuged to separate the absorbing sheep cells, are transferred to other containers, and are inactivated for fifteen minutes at 56° C. to eliminate anticomplementary qualities that are liable to develop during storage. The sera are now ready for distribution, and in the technique so far employed, two sets of four tubes have been used for examining each serum.

Front row tubes—				
Serum to be tested ..	0·0125	0·025	0·05	0·1
Saline	0·25	0·25	0·25	0·25
Back row tubes—				
Serum to be tested ..	0·0125	0·025	0·05	0·1
Antigen	0·25	0·25	0·25	0·25

To every tube is then added 1·5 m.h.d. of complement, as determined by the preliminary test, contained in 0·25 cubic centimetre of fluid and the tubes are incubated for two hours at 37° C. in the dry incubator. On completion of this period of incubation, 0·25 cubic centimetre of 2½ per

cent suspension of sensitized sheep cells is added, and the tubes are finally incubated for one hour at 37° C. in a water bath when the final readings are taken.

Lysis should be complete in all the front row tubes and in those of the back row there should be absence of lysis in the case of positive sera and complete lysis in that of negative sera. It need hardly be pointed out that known positive and known negative controls must be included in each batch of tests carried out.

V.—Results obtained with this Technique in a Series of One Hundred Different Sera from a Variety of Cases attending a Venereal Diseases Clinic.

Serum from patients attending the venereal diseases clinic of the City of Dundee was sent to the laboratory unaccompanied by any information as to the nature of the case, so that observations based on the complement fixation reaction would be unprejudiced by clinical information. After the tests were made the case sheets were scrutinized to correlate the findings obtained with those derived from clinical and microscopical examination.

Briefly the findings may be tabulated thus :—

	Fixation test	Microscopical examination	
a.	Negative ..	.. Negative ..	37
b.	Positive ..	.. Positive ..	37
c.	Negative ..	.. Positive ..	16
d.	Positive ..	.. Negative ..	6
e.	Antihæmolytic	.. ..	11
		Number of testings ..	107 on sera derived from 100 patients.

The findings under headings "c" and "d" call for comment. Of the sixteen cases under heading "c"

Six were of only one week's duration prior to the test being made
Two „ twelve days' „ „ „
One „ five weeks' „ „ „
One „ six weeks' „ „ „
Two were of two months' „ „ „
One was of three months' „ „ „
One „ four months' „ „ „

Two were of doubtful duration, showing therefore eight cases in which a positive result might reasonably have been expected if duration of infection be the only factor considered in relation to the development of a positive reaction. There is, of course, the "severity" factor also to be borne in mind, but the assessment of this presents much difficulty. These eight cases should be regarded frankly as "failures of the test on the negative side."

The six tests under category "d" are of much more significance, for

they may represent error on the positive side, but of them one had had gonorrhœa one year previously, although the discharge now appears to contain no gonococci. Two, although negative, microscopically have vaginal discharge, and the husband of each is, or has been recently, under treatment for gonorrhœa. Three, although negative, microscopically are regarded clinically by the venereal diseases officer as cases of gonorrhœa.

It is significant that all six cases in this category are females.

In addition there were fifteen cases in which gonorrhœa was excluded, and from other sources five further such specimens were tested. These cases could not be included in the series of 100 cases as microscopical examination of discharges was not made. In one case only of this series of twenty was a positive report given. Whether further observation and examination will show this was, or was not, a false positive reaction remains to be seen, but meanwhile it should be regarded as such and its occurrence indicates that the quantity of complement used, 1·5 m.h.d., is dangerously small. For this reason a second series of 100 tests is now being made using 2 m.h.d. of complemeut, and when the results of this series are available a report will be forwarded.

VI.—Discussion.

I was rather surprised at the remarkable agreement between the various methods of examination, and excepting the one case noted above, it did not appear that the delicacy of the reaction was introducing a serious experimental error on the positive side; nevertheless, it would be well to perform a similar series of tests, using a larger quantity of complement; for if in such a series there did not appear to be an undue lessening of the delicacy of the reaction, its accuracy would indubitably be enhanced.

Another matter deserving of special note is that the technique so far employed is much too laborious ever to become popular, but the four dilutions of serum were necessary until further information was available. A review of the results so far obtained shows that if the test were limited to two tubes—0·025 and 0·05 of the serum under examination with corresponding controls—only in three instances of the series would the result have been differently interpreted from that obtained with the series of four tubes. Moreover, in twenty-one instances, the tubes containing 0·1 cubic centimetre of serum exhibited a greater or less degree of inhibition of hæmolysis—although in only eleven instances already noted was this sufficiently marked to interfere with the correct interpretation of the results. This suggests an alternative arrangement of the test, viz., to test the serum in quantities of 0·0125, 0·025, and 0·05 in presence of antigen, and 0·05 only in absence of antigen, discarding all results in which any inhibition of lysis appears in this control. Such a scheme might be too exacting, in that a fair percentage of antihæmolytic sera would be noted even under these conditions, and it might be that a slight degree of inhibi-

tion in the 0·05 control, along with *complete* fixation with antigen in presence of 0·0125, should be interpreted as a positive result; but this technique is worthy of trial because of the saving of material and labour.

Again, the preliminary absorption with sheep cells of the sera to be examined, although from the research point of view advisable, may in practical work be really unnecessary. A duplicate series of tests, in which the same sera (i) previously absorbed, and (ii) untreated, and tested with the same reagents at the same time would have to be carried out. This will receive attention as soon as possible, and, as a preliminary thereto, a series of 100 sera are being tested without previous absorption, so that the results obtained may be compared with those herein considered.

Yet another aspect of the subject under consideration must not be lost sight of, namely, that the "liquid-air" antigen is not really practical. While it is true that substantially the same results can be obtained with a six-hour antigen prepared with *certain* strains of the gonococcus as are obtained with liquid-air antigens as noted under III, it remains to be seen whether the suitability of these strains for this purpose is a constant or merely a transient quality.

Apart from these considerations, one fact of considerable importance emerged from the work done. The fractional multiple—1·5 m.h.d.—of complement used leaves so small a margin for non-specific anticomplementary activity that technical error is liable to be introduced, and as a special aspect of this one had to be completely satisfied that no fixation took place with a gonococcus antigen in presence of serum derived from a case of syphilis in which gonococcal infection could be excluded. It may seem unnecessary to stress this, but while there is abundant evidence that serum from cases of gonorrhœa, in which syphilis can be excluded, does not give a positive Wassermann reaction, there is not the same overwhelming evidence that syphilitic sera do not give non-specific fixation in presence of bacterial antigens. This is important, for the "antigen" used in the Wassermann reaction is, after all, only a suspension of lipoids, and lipoids are important constituents of all micro-organisms. Fallacy arising from this cause is, I think, excluded by the following findings, in which the Wassermann reaction and the fixation test were carried out with the same sera and compared.

Wassermann reaction		Gonococcus fixation		
Positive	..	Negative	..	18
Negative	..	Positive	..	14
Negative	..	Doubtful	..	5
Positive	..	Doubtful	..	1
Negative	..	Negative	..	34
Positive	..	Positive	..	11

There is, therefore, a positive disagreement in thirty-two instances and a positive agreement in only eleven, and of these eleven sera all were derived from indubitable cases of gonorrhœa complicated by syphilis, or cases of syphilis, in the female, in which there was strong presumptive evidence of gonorrhœa.

CONCLUSIONS.

(1) A method is described for conducting the complement fixation test in gonorrhœa, based on the use of an antigen which is not in itself anti-complementary.

(2) A simple method of preparing a non-anticomplementary antigen is also described.

(3) This renders possible the use of a small (fractional) multiple of the m.h.d. in the actual test. So far the tests have been carried out with 1·5 m.h.d., but it is hoped that 2 m.h.d. may be used instead because of the danger of non-specific reactions being obtained when 1·5 m.h.d. only is employed.

(4) The paucity of humoral reaction in most cases of gonorrhœa renders necessary the absorption of complement with the cells of the hæmolytic system prior to carrying out the test.

(5) For the same reason, and also because of possible heterogenetic relationships, it seemed advisable to absorb the various (human) sera to be tested in the same way before carrying out the reaction. A further series of tests is being made to determine whether this previous absorption of sera to be tested is really necessary.

(6) The number of cases so far investigated is too small to permit of any definite conclusion being drawn as to the clinical value of the method, but there is evidence of a high degree of specificity, and also of considerable delicacy of reaction.

(7) Positive Wassermann sera from cases of syphilis, uncomplicated by gonococcal infection, do not give non-specific reactions with the technique described.

For valuable assistance and for untiring interest in the work I am indebted to Dr. G. R. Ross, Dr. W. Cumming, and Mr. A. Small, of this laboratory, without whose help the investigation could not have been prosecuted. Special thanks are due to Professor Peddie and Mr. Stark, of the department of physics, University College, Dundee, for a regular and generous supply of liquid air. My gratitude is also expressed to Dr. Laird, Venereal Diseases Officer of the female clinic of the City, and to Drs. W. A. Alexander and C. Averill, who are temporarily in charge of the male clinic, for supplying the clinical material, and also for copious notes of the cases investigated.

I have also to thank Professor E. Weymouth Reid, F.R.S., Professor of Physiology, University College, Dundee, for permitting me to quote in this report the results of his experiments dealing with the influence of variation of hydrogen ion content upon complement fixation.

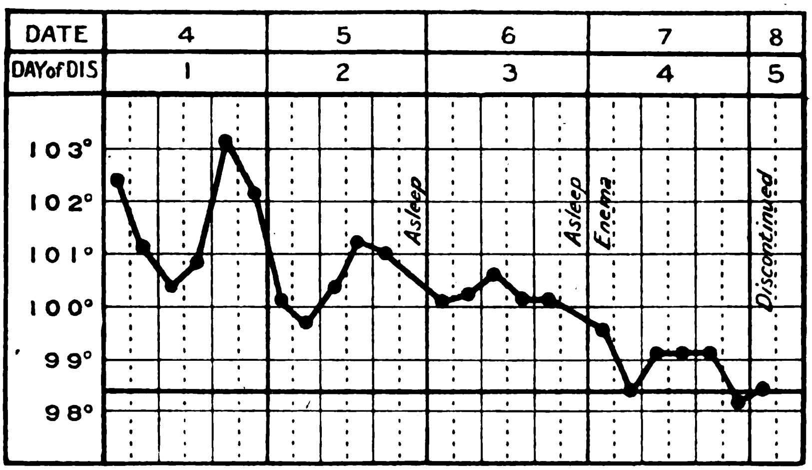
Clinical and other Notes.

CASE OF HÆMORRHAGE INTO THE ARACHNOID CAVITY.

By Major H. C. HILDRETH, D.S.O.
Royal Army Medical Corps.

GUNNER S. was admitted to the Military Hospital, Spike Island, on February 4, 1923, complaining of pain in the small of the back—the pain was of an acute character localized about the level of the second lumbar vertebra more to the right side. There was tenderness on pressure, but no evidence of inflammation. Temperature 102·4° F.; pulse 88; respirations normal; bowels not opened. His general condition was good; fresh-looking healthy lad, age 22, service two and a half years.

Previous History.—States as an infant he had a fall on his back; remembers having fever with pain in right knee (probably rheumatic). Since enlistment no admissions. Family history good; nothing abnormal. Patient was very irritable and preferred to remain undisturbed.



Treatment.—Rest. Diet. Locally the warmth of hot-water-bottle gave relief. Mist. sodii salicylat. appeared to ease the pain. The patient's recovery was gradual, the pain became of a dull nature and finally disappeared. He was then given Easton's syrup. At the time of discharge from hospital on February 17, 1923, he was given light employment in the officers' mess.

The temperature was puzzling, but in view of the fact that nothing could be detected to account for it, diagnosis was returned as myalgia.

On February 26, 1923, whilst going to his quarters he fainted and was brought to hospital on a stretcher.

Condition on Admission.—Unconscious; pupils widely dilated; reflexes absent; Kernig's absent; heart and lungs normal. Patient was given an enema with good result and kept under observation.

On the 27th the patient partially regained consciousness, asked for the urine bottle, and answered questions after repeated and louder questioning. Temperature 99° F. Slow and deliberate cerebration. Pressure over present site of pain elicited pain of short duration; there was tenderness on percussion of vertebra in the region; reflexes were absent.

C.N.S. Motor System.—On the 28th slight K. G. and loss of plantar reflex right side; loss of power in lower half right leg. The bladder was empty. Micturition and defæcation were normal.

Sensory System.—There was marked impaired sensation of both legs to touch. An area of hyperæsthesia was present on the right side commencing approximately at the level of the second lumbar vertebra and extending downward and forward to the crest of the ilium and forming a half girdle round the right side. There was tenderness over the left lumbar vertebra on deep pressure; but pupils were dilated, and reacted sluggishly.

Dr. Ashley Cummings of Cork kindly came in consultation on the 28th and to him I am indebted for the diagnosis of the case and notes.

Lumbar puncture was immediately performed by Dr. Robert Cummings to whom I am also indebted for his notes on the bacteriological examination.

The fluid was at first clear and under considerable pressure it was followed by a considerable quantity of blood. The cerebrospinal fluid was normal, except for the blood present. The blood effused had apparently gravitated to the lowest part of the canal, and in consequence did not flow until the excessive pressure in the cerebrospinal fluid was relieved. The presence of anæsthesia in both lower extremities, loss of the reflexes, etc., and sudden onset, appeared to indicate compression of the lumbar cord.

With reference to the cerebrospinal fluid, if the blood present had been due to laceration of a spinal vein on puncture by the needle, hæmorrhage would have occurred and blood would have been present in the first fluid drawn off, and the fluid would have become clear as the pressure became relieved.

The patient's condition showed marked improvement after lumbar puncture; the pupils were less dilated and pain was relieved. Recovery was very rapid and uneventful. Sensation returned in forty-eight hours and the motor system within the week was normal. He was placed on a mixture containing ergot and pot. iodide for the first few days after operation.

He was discharged from hospital on March 23, 1923.

NOTES ON THE USE OF ARTIFICIAL LIGHT IN SANDFLY DESTRUCTION.

By Major G. E. CATHCART, O.B.E.
Royal Army Medical Corps.

Major Boyd's notes on the sandfly group have a peculiar interest for those of his readers who have, for their sins, served in Iraq. During the summer of 1917 I happened to be in command of a combined Field Ambulance camped for the time close to Hinaidi (the seat of Major Boyd's present entomological operations). All ranks suffered considerably from the attacks of sandflies, and several of us were infected with that brief but distressing fever. My personal experience of an attack varies in one respect from Major Boyd's. I found the malaise accompanying the onset so distressing as to be almost pathognomonic, and I rapidly became reduced to "a whimpering lump of misery."

We found, as Major Boyd describes, that none of the routine methods (repellants, etc.) gave us any protection worth mentioning, and I can cordially endorse his statement that such repellants have a strict time limit of usefulness, and are messy to a degree.

It was not till the early summer of 1918 that the measure I am about to describe was given a very limited trial (on a very small scale) by myself and two of my officers. The results were sufficiently encouraging to make one wonder, at the time, whether the method could be extended and applied successfully to the protection of troops, but a short spell of much-needed leave to Kashmir, which was followed soon after by the Armistice, put the whole matter out of my mind.

The method itself requires only a few words of description, and possesses the merit of simplicity.

The underlying idea being :—

(1) To take advantage of the primary instincts of the insect.

(2) To attract by this means as many as possible to a given surface.

(3) To destroy them on that surface.

Fig. No. 1 represents a hurricane lamp, prepared with vaseline, after one night's use; it is literally felted over with dead sandflies. The few scattered black spots represent the small proportion of sandflies which have succeeded in feeding prior to destruction. The rough original sketch was taken from a used lamp, in May, 1918, and has been reproduced here on a rather larger scale.

Fig. No. 2 represents a suggestion for extending the method for protection of larger bodies of troops. The idea being to extend the attracting and killing area to the utmost limit of practical utility.

The actual method of using the lamps for this purpose is as follows: A thin coating of vaseline is rubbed with a swab over the entire surface of the glass and metal before lighting. The lamp is then lighted, but not turned full on. The prepared and lighted lamp is placed or suspended

three to four feet above ground level in the centre of each group of four to eight cots, and is allowed to burn all night.

If used on field service the lamps would naturally require masking, as they would otherwise produce heavy casualties from sniping.

INDIVIDUAL PROTECTION.

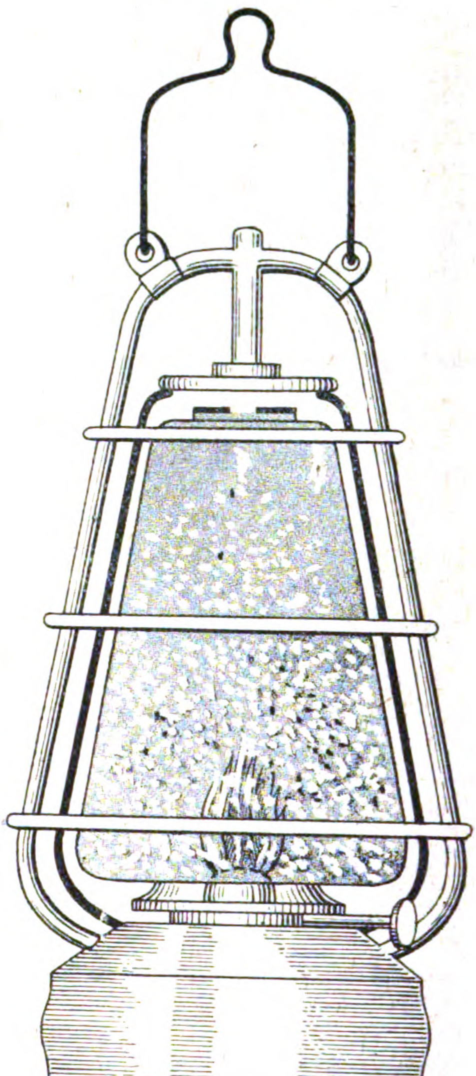


FIG. 1.—Showing "vaseline prepared" Hurricane Lamp, after one night's use. Outer surface felted with sandflies. Note small proportion which have succeeded in feeding before attraction and destruction.—*Copy from Sketch Book.*

Major Boyd observes that the female, after feeding, makes for the darkest spot she can find to rest. I presume this observation was made by daylight or by strong artificial light.

I believe that the habit may be reversed at night or in the dark, but should like confirmation of this. The attraction of a light appears to hold good whether the flies are hungry or fed.

Alternative preparations may consist of fly papers (illuminated). The results from these were not so striking as the smeared lamps.

Bird lime could be used, but it is open to two objections: (1) Difficulty in handling; (2) tendency to catch the larger moths and finally obscure the light.

To give the system a fair trial the following steps are recommended, in addition to the lamps.

(*a*) All cots should be remade after sundown, the bedclothes, blankets, mattress, pillows, etc., thoroughly shaken, and the entire cot, when remade, should be covered by a sheet.

(*b*) Individual chaquls or other moist articles should not hang in the vicinity of cots.

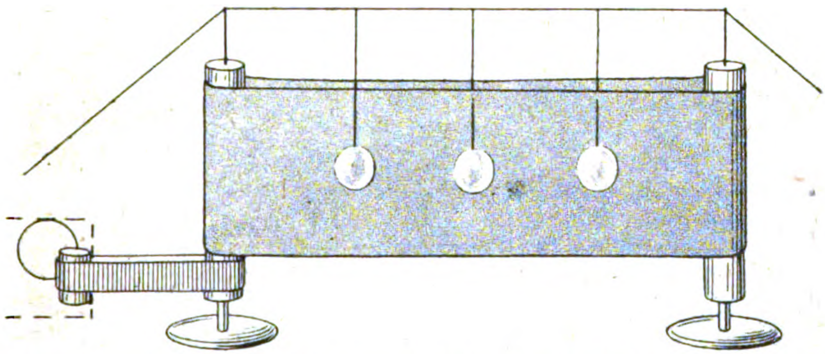


FIG. 2.—Semi-transparent revolving screen, propelled on vertical rollers by slow clock-work, Illuminated by electric bulbs. Screen material, linen with external coating of vaseline or adhesive matter. (Designed for attraction on large scale.)

(*c*) Bed spaces and dormitory floors should be scrupulously dry, and should be thoroughly swept after sundown.

(*d*) Repellants should be used, as a routine, on exposed parts of the body.

(*e*) The usual spraying methods should be continued for destruction of the flies.

It might be thought that the proximity of a light would attract more sandflies to the sleeper than would otherwise be the case. The very small proportion of "fed sandflies" found on the lamps in the morning seems to prove the contrary. I can state positively that the relief given by the use of the lamp is very considerable. We had been using the ordinary repellants for a considerable time without any appreciable benefit, and we continued to use them, in addition to the lamps, and although we continued to be bitten occasionally during the night, we were now able to sleep

soundly, which some of us had been utterly prevented from doing before taking the lamps into use.

The system has, I admit, been given a very limited test; conducted on no scientific basis, under field service conditions, and several points occur to me which appear worth further investigation.

(1) The optimum distance from cots to lamp.

(2) The optimum degree of illumination.

(3) The optimum material for use on lamps.

(4) The optimum rate of movement for illuminated screens.

(5) The optimum material for screens and adhesives.

(6) A few central cots for observation.

(7) The actual distance at which sandflies can perceive and be attracted to artificial light of a standard illumination and visibility.

I regret to say I have no knowledge regarding the actual methods by which the so-called "repellants" are selected for issue on field service. That their efficacy might be increased is, I think, an opinion very generally held.

On a few occasions we actually made use of a repellant (Paraquit of doubtful age) to smear on the lamps, and found a very fair proportion of dead sandflies on the surface.

It seems possible that a few tests of the comparative efficacy of these repellants could very easily be carried out with variously prepared lamps, using vaselined lamps as a control.

It is perhaps hardly necessary to point out that no claim for absolute protection has or could be made for the measures outlined. At present I can see very little likelihood of success in this direction.

On the other hand I am strongly of the opinion that these measures when extended and amplified, after investigation and improvement of technique, should afford a real measure of relative protection against sandfly fever.

In conclusion, the method might, in my opinion, be usefully adapted to combat malarial (hut or barrack) infections; the lamps being used in the same way, for the attraction, destruction and identification of infected anophelines.

A small scale trial, as above, was in process of starting at Signal Hill (Sierra Leone), when I left Wilberforce to come into hospital, but up to the time of writing no results have been available.

Travel.

YARNS OF A SHIP'S SURGEON. THE "WASP" AGAIN.

By Lieutenant-Colonel C. R. L. RONAYNE.
Royal Army Medical Corps (Retired Pay).

(*Continued from p.* 388.)

First impressions on going to the Far East are that the Straits of Malacca constitute a sort of half-way house between the Near and Far East.

At Penang one sees a large number of Indians, though the Chinese easily predominate. At Port Swettenham the number of Indians is proportionately less. Whilst at Singapore it is less again.

Then Hong Kong and Shanghai are wholly Chinese, I mean except for Europeans, Indians, and Japanese, who really constitute only a sprinkling in proportion to the teeming native population.

Another "first impression" is that, broadly speaking, the language difficulty constitutes almost an insuperable barrier between the West and Near East on one side, and the Far East on the other. One is accustomed at Continental ports, Mediterranean ports, and when travelling in India, etc., to have little or no difficulty over language. But once past the half-way house of Malacca, I found the change and inconvenience very great. The majority of the various dealers and touts who came on board ship have only a few words of very imperfectly pronounced English; and "conversation" with them is generally purely monosyllabic and very limited. Pocket-dictionaries, and useful phrases phonetically spelt, which often can be such a help elsewhere, are no use in China and Japan.

Even those who can converse a little are usually confined to their particular "line" of articles, or business. For instance, a Japanese dealer may be able to give you quite intelligent information about his laquer goods, but ask him "where does this street lead to" and he is bowled over at once. He simply doesn't understand, no more than if you spoke double Dutch to him. I have had several experiences of this sort.

Things of course are all right in the European shops; but if only for sentimental reasons one often prefers to buy, especially curios, in the native shops; there the language difficulty is generally a great nuisance. After all it is only natural there should be this difficulty, as a chasm broad and deep separates the languages of the Far East from the Indo-European group, known as the "Aryan family." The difficulty between these two great groups is over *inflection*.

In the Chinese group words are incapable of inflection, and each word or sound represents an idea in itself, and it is by an agglutination of

individual words that composite ideas are represented. Whereas inflection is the great characteristic of the Aryan group, and so anyone in this group can with comparative ease learn the language of another of the group. For example, an Indian could learn French in a fraction of the time he would take to learn Chinese.

By the way, that wayward scholar and traveller, Major E. B. Soane, who died recently, has shown the Kurdish language to be a distinct language, and not merely a dialect of Persian, as it has hitherto been considered. Unfortunately the dictionary of the language which he had been working on had not been completed before he died.

I believe it is the "correct thing" to describe the Chinese as liars, lazy, dirty, and dishonest. My brief visit did not suggest any of these. In the river life, notwithstanding the overcrowding, I always noticed comparative cleanliness. Everybody from the infant up seemed to have his job and to follow it assiduously. Even the youth who slept as he fished would have promptly jumped up if he got a bite.

On the contrary, a cursory visit leaves pleasant impressions. Their open, good-natured, always smiling faces are pleasing; and especially pleasing is the soft modulating tone of the voice, so naturally musical and gentle. They seem never to get ruffled or lose their tempers.

Out East when in dock it is customary to have all sorts of people come knocking at your cabin door. One wants to mend your boots; another to sew on buttons, and so on. One day when I was busy I was worried by callers one after another, until at length, in pretty stiff language, I told one of them to clear out. He beamed on me with a broad smile and said, "Au—gooood byee." They often say this. Of course such a remark in such circumstances, and made by a person who knew the difference, would be cheeky sarcasm. But not so with them; it is their idea of *comme il faut*, and is made with the best intention, and is really amusing. In this particular incident I was so amused I called him back and bought some cuff-links from him.

Not being on the Stock Exchange nor a gold expert I cannot say why gold should be cheaper and more plentiful in China than elsewhere. I thought currency always balanced itself between different countries. But the fact remains, gold is cheaper and more on tap in China than elsewhere: at least I found it so.

The Chinese appear to suffer a good deal from dental decay; and where you and I would be satisfied with a little cement filling, the Chinese coolie prefers gold.

I think I am not exaggerating when I say fully fifty per cent of the coolies working on the ship, when they beam on you—and they are always beaming—display a mouth stuffed with gold. It is quite remarkable the numbers of very poor one sees with gold fillings.

Various kinds of cheap jewellery and ornamental work, a sort of *cloisonné*, are inlaid with gold, and it is nearly always eighteen carat.

I bought a pair of gold links for (the equivalent of) about 26s. I had them recently valued, and the jeweller said they were eighteen carat, and worth about £3.

I may mention most of my purchases were made from native shops and dealers in Shanghai and Japan.

I believe everything one could wish for can be got at Hong Kong; but I was informed the prices there are somewhat stiffer. Likewise everything can be got at Calcutta, but prices there are much higher—at least judging by one experience I had. Thus, at Yokohama I bought two vases of "Satsuma ware," for which I paid the equivalent of about 30 shillings for the pair. Later on when passing a shop in Calcutta I saw two Satsuma vases in the window which were identical in size and in every way to the ones I had bought; so through curiosity I went in and inquired the price. I was told Rs. 51. That is nearly £3 10s.

I made a point of getting some silk in China, and not Japan—I did this because I was told the Chinese silk is made altogether on hand-looms, and so is better in quality, and more lasting than that made in Japan, which is machine-made.

After leaving Shanghai and having escaped the typhoon, we arrived in due course at Moji, the first port in Japan. The place is a coaling station pure and simple, and no more than a village.

My first experience of the Japs was with the port medical officer, and I must say I was not too favourably impressed. He could speak English only very imperfectly, was dirtily dressed, and when I offered him a cigarette both he and his two assistants put their hands in the tin and each pulled out a handful.

The Japs are not now in favour as they were when they were beating the Russians. I must say, however, I found them always very obliging, courteous and pleasant; as for instance, my experience with the doctor and his assistants, which does not support any allegation of uppishness. When you offer a cigarette to an uppish or "sidy" person, he refuses, or perhaps condescends to take just one—never a handful. I only wish they had been uppish on that occasion!

Indeed, it seems to me almost impossible to imagine uppishness or swelled headiness going hand in hand with the graceful and pleasing curtsy they so frequently and on the slightest pretext make. All classes equally make this bow, and the sincerity and gracefulness of it is very taking.

If you have been through the Inland Sea of Japan I really think you need not bother to see any other of the world's "beauty spots," as this is of such surpassing beauty. It is, roughly speaking, about 180 miles long, and the whole distance is one continuous chain and endless variety of every delightful scenic effect imaginable. We saw it at its very best, bathed in calm and sunshine—but I am told it is possible to go through and see nothing owing to mist and haze, and that this occurs fairly frequently.

When we arrived at Kobe we found we had just missed a typhoon there. After discharging some cargo, we weighed anchor and set sail for Yokohama. When about seventy miles from Kobe one of the quarter-masters called attention to a speck in the water.

At sea it is, of course, very difficult to "spot" and find out what a small floating object is. It disappears in the hollow of a wave or swell, and when you see it again, before you have time to get your glasses properly on it, it is gone, and so on. But from occasional glimpses caught, some thought it was a man, so the ship was hove up and a boat put off. And sure enough, there was a Japanese man on a balk of wood, straddle-legged across it, and lying on his stomach, so weak that he could only move his head, and could not raise himself up. After some manœuvring to avoid injuring him, he was got into the boat with difficulty.

By the time he was on the ship he was "as good as dead," as the unavoidable pulling and hauling he had just been through seemed to be about the last straw. So time did not permit of much more handling, and as the deck was hot and sunny he was wrapped in blankets and hot bottles were applied.

One naturally took a special interest in such a case, so it was anxious work watching him, as he showed no signs of reviving. He seemed to be completely numbed and in a sort of "cerebral" condition, with slow, shallow breathing and no pulse. But he was a young man, and his powerful physique stood to him, and after some hours he showed signs of life, and from that on improved steadily, so that he was nearly quite recovered by the time we got to Yokohama. Of course he could not speak a word of English, so we had to wait until we got to port to hear his story. He was one Kowaowka Yousabero, a "hand" on board a small coastal trading ship, having a crew of five, including the captain-owner. There were also two passengers on board—a young married couple, who had only just been married. They got the full force of the typhoon, and one wave which struck the ship not only capsized her but broke her to matchwood. He never saw any of the crew or passengers again. He said he thought the log he was on was a piece of the ship's keel.

About a mile in front of us, also going to Yokohama, was a large Japanese steamer which Kowaowka said had nearly passed over him, but nobody on board saw him; and as we were not in her wake, but a good bit further off, he said he had given up all hope, as he had been over twenty-four hours in the water and had got a fearful buffeting from the waves for more than twelve hours (the sea had gone down a good deal when we rescued him). Besides night was coming on.

Some days after when at lunch I was told the Japanese sailor was outside my cabin and wanted to see me; on going out, there I found Kowaowka arranged in a beautifully striped kimono, held at the waist by a cummerbund of bright yellow and azure blue. He looked such a "nut" I hardly knew him. He had a basket in his hand containing two dozen of

beer which he gave me—an interpreter at the same time making a suitable speech, during which Kowaowka repeatedly curtsied in the charming Japanese fashion. Of course I thanked him, but I did not tell him that it was not to me but to the crew who rescued him that he should have made the present. I duly passed the beer on to the crew of the boat.

On arrival at Yokohama we found we had just missed a fearful typhoon. This was really the worst of all, as no less than six ships of over 4,000 tons had gone down in it, besides smaller craft of all sorts.

In the American colony there was great anxiety over a ship of theirs which became much overdue—however she turned up all right after some days, having experienced the full force of the typhoon. When she arrived

A pretty bit in the park, Tokyo.

she had, I believe, only about a pint of oil fuel remaining in her tanks. I never quite understood what she was; but I gathered she was on some sort of a "commercial mission." She had commercial "big wigs" on board; but what seemed curious was, she was "run" by naval officers. She was a fine-looking ship, painted all white, and rather of a semi-yacht, semi-warship design. She reminded me somewhat of the Kaiser's yacht the "Hohenzollern."

On leaving Yokohama we wormed our way along, dodging the typhoons, until once again we fetched up at Hong Kong. Here I found a note awaiting me from Major P. S. Tomlinson of the Corps. The latter asked me up, not only to tennis, but also to lunch and dinner. Such kindness I thought,

as I had never met him before, except just casually when we called at Hong Kong on the way out. As our ship was over at Kowloon I had rather a long way to go. First I crossed to Hong Kong in a boat—I could have gone by a ferry steamer, but the boat was more convenient and nearly as cheap. Arrived at the quay, I jumped into a rickshaw and told the man to drive to the top of the rock; then I would direct him further. Broadly smiling he replied with confidence, "Yau, me understand," and off we buzzed. After rattling along for some time, I began to get familiar with the streets, and soon realized we were simply doubling in and out from one street to another.

I have already referred to the language difficulty in the Far East, and it is on an occasion like this it can be brought home to one. The heat was of course then very great, and any Europeans about were in rickshaws or other conveyance. And one could not well stop a man flying by in a motor, merely to ask him the way. So that it is possible, under such conditions, to potter about for a considerable distance without being able to get information. Policemen are no use; as a rule the only English they know is "yau"—perhaps Hong Kong is somewhat an exception, as there Sikhs are employed as policemen. But then how many visitors can speak Hindustani? Fortunately I know enough of the language to carry on with, and so I pulled up opposite a splendid specimen of a Sikh with curling beard. He then told me the rickshaw walla could not take me up to the aerial-railway, let alone the top of the hill; I would have to go to the railway in a "dandy," or walk to it; and that the railway was very near. Very near! yes, only just 200 feet above me! How I did perspire climbing those 200 feet!

This mountain railway is a splendid institution. I do not know whether it is owned by the Government or a private company, but it ought to pay well judging by the crowds which patronize it. Anyway it shot us up 1,305 feet to the Peak in double quick time, where we breathed the cool, rare and refreshing mountain air—at least it seemed so by comparison with the heat below. Whether going up or down, you always sit facing upwards in the carriage; in parts, the ascent is so perpendicular, we were lying on our backs against the back of the seats, with our feet sticking up high in the air. The lady passengers did not seem to resent the attitude as undignified—indeed it would be little use for them to do so, as owing to the position they were in they were practically powerless to move, let alone get out and walk.

Arrived at the Peak (it is only "peak" in name, as the real peak of the rock is more than 400 feet higher up), I was sporting enough to entrust myself once again to a rickshaw-walla. I had heard that the fellows up in the cool air of the Peak had cooler and more intelligent heads, and actually knew the numbers of the bungalows. So I told him to peg off as hard as he could to bungalow No. 66, as I had lost a good bit of time already owing to my little escapade below. But it was only natural I should be dis-

trustful, and I watched with anxiety as he ascended by devious paths. However, he brought me to the bungalow all right—a charming one picturesquely situated on a spur of the Rock, and commanding a delightful view.

Though I was a little late I found T. had not yet returned—he had telephoned up he was detained at the hospital. If I remember rightly, it was over a case of a man who had fallen down a khud or out of a window and was badly injured. But in due course he arrived, and after an excellent lunch we were sitting on the verandah smoking and sipping coffee and looking down on the truly enchanting scenery which lay beneath us extending away in varied and apparently limitless panorama. I had just relighted my cigar—though perhaps I should not admit this, as I believe connoisseurs do not relight cigars; but it was such a good one I seemed to do it automatically—when some friends they had asked up to tennis were announced, and in they came in full fighting kit—jumpers and cardigans on arm, rackets in hand.

As a result of experience, one instinctively becomes a little suspicious about private courts; but any uneasiness I may have felt on this score was soon dispelled. The court was in top-hole condition, and we had really a grand afternoon of it. Both "mixed" sets and men's doubles.

Then came dinner—and here I am afraid I rather "gave myself away," as I ate all that was put before me, and even so far forgot myself as to ask for a second help of a particularly delicious dish. It is such bad form you know nowadays to eat a square meal!

I did not get back to the ship until late that night—the end of a perfect day.

Between Japan and Hong Kong we had shipped a good deal of valuable cargo in the form of silk and tea; silk is especially valuable as the freightage on it is very high. We had also a good number of passengers on board, though we were not full as it was the "hot season"—still the fair sex was well represented.

I do not know whether it may be due to the iodine in the air, or perhaps the ozone; but why is it that life on board ship has such a demuring and self-effacing tendency on the fair sex? Even girls who have hitherto been noted "tomboys" seem to become reserved and shy as soon as they set foot on board. But indeed this tendency to reserve and self-effacement has recently sprung up, and is now noticeable amongst the sex on land as well as at sea; and unless we men take timely steps to counter it, we will, perhaps, before we know where we are, find ourselves back in the "fifties," so to speak, and surrounded once again by "mid-Victorian" women. It is quite alarming the way women are now shrinking from publicity and notoriety in any form.

Only recently a lady friend of mine, surfeited with the "turkey trots," "bunny hugs," and bridge-parties of Mayfair, decided to break away from her life of gaiety and pleasure, and henceforward to devote herself to

altruism and self-effacement. And to do this she decided to become a trainer and stable-boy.

In selecting this life her idea was, that so few of her sex become stable-boys there would be no difficulty in ensuring self-effacement; and she argued that her spurs, stowazers, riding-breeches and jockey cap would materially help in completing the disguise. But the wily editors of the Society journals got to hear of her soon enough, with the result that the interviewers and camera men rolled up at the stable *en masse* one day, and the poor girl was quickly surrounded. In order to get rid of her tormentors she allowed herself to be freely "interviewed." She even allowed them to take photographs of her.

First she was photographed just as she had come from the stable—and I must say she looked extremely smart in her breeches, spurs and spats. A truly superb specimen of a lithe outdoor athlete.

After it was taken she disappeared, and in scarcely more time than it takes to say, "Straw presto, Jack Robinson!" she returned to the interviewers wondrously arrayed, and was immediately photographed reclining on a Chesterfield sofa buried in a bevy of downy cushions.

As she looked towards the camera in a dreamy ennuyée way, her azure eyes were irresistibly liquid, and were wistfully concealed beneath long, curving, luscious lashes. Her right hand idly toyed with a rope of rich pearls around her neck; whilst the forefinger of her left hand lightly rested on her chin—the remaining fingers falling on her neck and shoulders in willowy natural curves. A foot, taking barely "baby-3's" in high-heeled shoes, was exquisitely and with complete *négligée* poised in the centre of the picture.

The dress scheme was conceived in autumn leaf-brown drapery, and she wore a hat of silver-grey taffeta, on which was lying a large golden pheasant, his head reclining forward over the brim and gently caressing the cheek of the stable lad.

The photographs over, the regular interviewers stepped forward and listened in wrapped attention. She told them fox-hunting and lion shooting were her favourite sports. Tennis and golf she had no use for, as she considered them too effeminate. She spent much of her time embroidering handkerchiefs for the poor. She had a penchant for blue velvet hats; whilst she fairly doted on old pewter, of which she had already amassed a cellar full. But she told them, the *pièce de résistance* of her hobbies, when not lion shooting, was photographing ancient Roman Doric columns. These she thought had a subtle grandeur all their own, owing to the "tailor-made severity of design" which gave them a finish and dignity, as distinct from the more "flouncy and crinoline-like effect the canthus leaves gave the capitals of Corinthian columns, and made them look effeminate." She told them much more besides.

These announcements were punctuated by sips of liqueurs by the fair Diana, and chewing chunks of "chocs."

Altogether the interviewers were so astonished, that they concluded the interview with the following passage: "Interviewers, notwithstanding a superficial pleasantry and suavity of manner, are usually a pretty thick-skinned crowd; but in this instance they were fairly spell-bound and entranced by the penetrating personality, and 'arresting' originality of this truly remarkable young lady. They indeed predict a great future for her."

You will notice the closing remark is somewhat ambiguous, as they do not say how she is to attain the "great future."

Do they mean her name will be handed down to posterity as the greatest stable lad of all times?

The photographs and "interviews" were broadcasted in large print in all the papers. Thus she sought to efface herself—instead she got fame!

Another "Society" friend of mine also tried her hand at self-effacement. She announced, I mean renounced, her rank and social position, and then became a humble film-artist. Judging by most recent accounts I gather she has got effacement right enough—at least as far as acting goes.

Altogether I understand quite a good few young ladies nowadays find attempts at self-obliteration on the above lines unsatisfactory.

But I am afraid I am digressing a bit. We had by now well pushed off from Hong Kong, and were shaping our course due south, right into the teeth of the Eastern sun. However, the prospect of increasing heat did not alarm us, so overjoyed were we at the prospect of leaving the typhoon zone behind.

What a month of uncertainty and suspense we had been through! Our hearts, which during this time had been continuously in our mouths, now began to return to their normal positions. But let us draw a veil! With Helois I claim the privilege of the sundial, and henceforth will record only the hours of sunshine.

We did not call at Aden, but just as we were passing it out came the P. and O. ship "Sardinia," and steamed along only half a mile from us, and a couple of hundred yards ahead of us. We had a most exciting and interesting race up the Red Sea, literally steaming neck and neck; at one time we perhaps gaining 100 yards or so, then she pulling up, and going ahead a little.

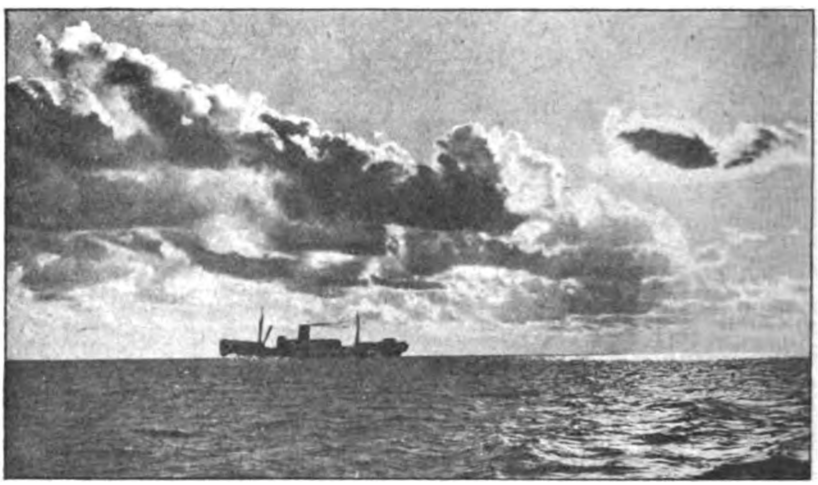
This went on day after day until just at the top of the Red Sea when we struck a head wind, and as we had a little more cargo than she, the additional weight told in our favour against the wind and slight head-sea, and so we pulled ahead. But it was really a most exciting and interesting tussle whilst it lasted.

Well, as I said, in due course we fetched up at Gibraltar one sunny morning—to be exact it was 6.30 a.m. on October 20, 1922. Breakfast was served on board a bit early, in order to give passengers a long time on shore; and I seized the opportunity to "see the sick" early and go ashore also.

On landing I made a bee-line for the office of the Hon. Secretary situated under the Saluting Battery, and I was fortunate to find him there (the genial Wheeler). After mutual greetings, I lost no time in popping the question—" What has become of the 'Wasp'?"

He said: "All we have to do is go up on the Bastion and you can look down on her riding to her moorings in almost the identical spot you left her."

So up we went, and right enough there she was. Two men were approaching her in a punt; R. W. remarking that it was a curious coincidence I should look her up at the identical time when two new owners were taking her over, as the men in the punt were new owners who had bought her *only the previous day*. So down we went, got the club punt, and put off. R. W. introduced me to the new owners, who were two nice young fellows of the E.T.C.



The race with the "Sardinia."

I went on board and carefully examined the old "Wasp." Being on speaking terms with every plank and rib in her, I was in a position to be critical, but 'pon my word I couldn't see any change in her. She seemed sound as a bell. I then asked the owners if it would not be too inquisitive to ask what they had paid for her. The reply was "£100." One hundred pounds, and I had sold her for eight!

I think they would scarcely have believed that I had sold her for this sum, or I have believed that they had given £100 for her, had not R. W. been present to verify the statements.

She did not appear to be quite as well found as when I had her—the sails for instance were not Lapthorn.

I was told she had changed hands several times since I had her, and had done fairly well in the racing line.

When we were going down from the Bastion to get the punt, who should we run into but Lieutenant-Colonel C. of the "Gunners"—known to his friends as "Uncle." He was at Gibraltar with me, and when I left I left him behind. Later on when I was stationed at Multan, who should roll up there but "Uncle"; then in due course when I left Multan I left him there. So of course we had a great greeting at meeting once again at Gibraltar. And I promptly snapshotted him and R. W. on the verandah of the Yacht Club.

"Uncle" wanted me to lunch at the "South" Mess, but unfortunately it was too far out, and had I gone I would not have been able to do all I wanted in the time at my disposal.

Later on I was very glad to meet Major M., also of the "Gunners"—doubly glad because he stood me a most excellent lunch at the "North" mess. There I met Captains F. and R., also old Gibraltar friends. As I sat opposite them at table I thought—what times have passed since I last was in your mess! I had to promise them I would lunch with them the next time I looked into Gibraltar.

You can't beat a "Gunners'" mess for genuine hospitality.

When we came ashore from the "Wasp," we went along to near the Torpedo Camber, where most of the yachts had been berthed already in winter quarters. There I renewed acquaintance with the "Buccaneer," "Rosalind," "Dingbat" and others.

In my article in the Journal of May, 1914, I referred to the "Dingbat" (when I was looking out for a boat to buy) in the following terms: "The 'Dingbat' was a six-tonner, a fine roomy weatherly boat, with a good turn of speed, and sound as a bell. She was just what I wanted, so I went to £10 more than I thought she was worth; but as the owner wanted another £10 no business was done." I may now add I was subsequently very glad I did not buy her.

Before making an offer, I had arranged with the owner to go for a sail in her; but on the day appointed for the sail he put me off on some pretext. It did not occur to me at the time that perhaps he had an ulterior object in putting me off. So I was not suspicious; and she seemed so sound, and suitable in every way, and I had heard such favourable accounts of her, I was quite prepared to buy her without a trial.

It was only a long time afterwards that I found out she took a fearful weather-helm, and was well-nigh heart-breaking—or rather biceps breaking to handle. As she now lay on the quay she had an unsightly sheet of iron plastered on to the aft part of her keel—evidently an attempt by some recent owner to mitigate her "griping"; and altogether she looked in rather sorry neglect and disrepair.

R. W.'s boat the "Lassie" was there also. As usual, kept up regardless of expense; and possessing every known (and unknown) device to ensure comfort and efficiency. For a boat of her size and lines, there is probably no boat to touch her for speed, sea-worthiness, and general comfort.

Before parting with R. W. I had to promise him I would lunch with him the next time I looked in. What commitments I made in the lunch line!—I dare not go back.

In a stroll through the town I met some old friends—local residents. I was struck by the unanimity with which they assured me trade was bad, and that everything was the same, "no change," since I had been there before. I cannot vouch for the conditions of trade, but I only hope they were as much out in their estimate of it as they were in their assurance there was "no change."

On a cursory walk around I saw improvements everywhere. Even before actually setting foot on shore I was struck by the great improvement and facilities for trade afforded by the addition of the pier to the North Mole.

There are no wharfs or quays for merchant ships to go alongside at Gibraltar; so all goods are landed, or shipped, by means of barges.

In my time the portion of the mole aft of where the Algeciras steamers berthed was a congested mass of bumping barges, lying one outside the other six and eight deep. Horrible confusion. Now the additional mole, or spur, which has been added on, and is broad and massively built, completely relieves this congestion.

But good and useful as this extension is, it has its faults. It starts in a north-easterly direction, and if it only continued in this direction it would afford complete protection from the nasty sea which runs in here with a strong north-west wind, and which causes much inconvenience in loading and unloading cargo, as well as damage to barges and boats through bumping. But unfortunately, after only a short distance in a north-east direction, the new mole turns sharply, and is carried towards the north-west. Why this should be, beats me—any advantage in it, in my opinion, would be much outweighed by the protection afforded by a north-easterly extension. But show me the pier or artificial harbour which has not got its disadvantage or weak point—only too often a disadvantage of this sort!

For the information of those who have not been to Gibraltar, I would mention that the Rock is separated from Spain by the "neutral territory," a strip of land, half a mile wide, extending across the flat isthmus from the Bay of Gibraltar on the one side to the Mediterranean on the other. No house or tree is to be seen on this strip of neutral ground; it is bare and deserted except on the single road which connects Spain with the Rock, and, as may be expected, the traffic on this road is considerable. But being on "neutral" ground, it was no man's darling and so it got into a shocking condition of neglect. That was before the war: now the road has a perfect metalled surface. Generally speaking the roads at the North Front were little better than the neutral road before the war. Now I found them all in perfect condition, with shrubs planted, and a general smartening up of the side-walks and precincts.

Especially good is the road to Cataline Bay; and when this scheme is

completed a delightful drive, completely encircling the Rock, will be provided, as the plans, I was informed, have already been approved to join the Cataline Bay road by a bridge, along the face of the steep rock, to the road leading to the "Governor's Cottage" on the east side.

The unsightly Bay Side Barrier gates have been removed, and near by is an imposing war memorial.

An excellent improvement is that by which after leaving the Bay Side Barrier and going towards the town, one has now the choice of three roads, one leading directly into the town, another along the Line Wall Road, whilst a third leads outside Water Port Gates to the Moles, and along the front.

But, next to the new pier, the best improvement of all is perhaps the gap made in the Line Wall, with broad steps leading down to the naval football ground. These steps confer a great boon on the people shut in in the town, as formerly they had to walk considerable distances round to Water Port Gates, or other gates, before they could get out on the front for a stroll and breath of sea air, or to watch a football match, hockey or other games. Now they can get out at a bound, so to speak.

There are other improvements, too, but the foregoing are the chief I noticed. "No change!"

I also managed to take a run up to the Sandpit lawn tennis grounds. There I found the groundsman (Conte) with his broad grinning smile as of old; he seemed little changed. He told me he had been employed on the courts for twenty-six years, and he is now 39 years of age; with his light-hearted grin and jaunty walk he looked more like 19. He assured me I was "a very good major," and that he liked me very much. There must be something radically wrong with the member whom Conte, at one time or another, has not addressed in similar terms. Good nature and flattery are innate in him.

But it was not to look up Conte I went to the courts, my real object was to see what had become of the "new court." In my time the three club courts were found insufficient for the demands on them, so a site for a new one was levelled off, and a contract made with a "home" firm for one of those red rubble ones. The contract, as well as I remember, was the club was to provide ninety tons of cinders, whilst the firm provided the rubble, and laid it for £100.

It was duly laid, and I played on it a few times, but I recollect it was very loose and rubbly, and it did not improve as it was supposed to do. This, I believe, was attributed to the local brackish ("sanitary") water with which it was watered, and which was not considered suitable for the purpose.

Conte could not enlighten me on the reason why, but I found the £100 worth had been scrapped, and the court converted into an ordinary "mud" one, the same as the others. *Experimentia docet.*

By the way, it is not generally known that the deepest borings in the

world, in an effort to strike fresh water, have been made at Gibraltar. These, of course, were made at much expense, but the expense was fully justified as, had fresh water been struck, the huge outlay on blasting out the great tanks which subsequently had to be built in the interior of the rock to supply fresh water during the dry season, would have been saved. Even from the deepest borings the water drawn up is always brackish.

It would appear the few decent clothes I have are destined to be spoilt by the sea at Gibraltar.

In my article on "Yachting at Gibraltar," I related how I fell into the sea with a "West End" suit, and on this last call at Gibraltar I had an experience which, for all practical purposes, was similar, as far as clothes are concerned.

Boys diving for money at Malta.

Instead of returning to the steamer in the tender with the passengers, I thought I would like a row back, so I went to the Yacht Club and got the attendant to take me out in a punt. When we got near the Mole entrance it commenced to blow very hard from the north-east, and a nasty steep little sea quickly got up. We shipped a lot of water, and I thought we would be swamped; but anyway, by the time we got to the steamer I was just as wet as if we had been.

Why is it there are no diving boys in Gibraltar harbour, whilst diving for coins is a flourishing industry at Malta? It cannot be due to climate, because the climatic conditions of both places are practically identical.

Passengers, and especially those making their first voyage abroad, aré always interested in this diving, and one often sees a coin thrown into the water with much force in order to make it difficult for the diver to get. But this is wasted energy, as the coin quickly turns on its side, and the initial energy being lost, it slowly flutters to the bottom, flashing and glittering as it goes, and to recover it is comparatively easy, much easier than is thought. Boys seldom go for copper coins as they do not flash. It is not recovering the coin that fascinates and interests me but the way they get in and out of their canoes. The canoe in the foreground from which a boy has just dived (see snapshot) well illustrates this; it can be seen to be a mere wobbly shell, scarcely a foot in beam, and upset by the least thing. To jump from it quickly (as the boys do) without upsetting it, is extremely difficult, but to get back again is doubly so, and really requires marvellous dexterity. Yet I have never seen a boy upset his canoe getting either in or out.

Echoes of the Past.

EXTRACTS FROM REGULATIONS 1808.

By Major W. R. GALWEY.
Royal Army Medical Corps.

The Editor, thirsting for copy, has given me two old books of Regulations and asked me to reconstruct from them a forgotten organization, a not uninteresting task.

These books are "The Instructions for Agents and Surgeons under the Commissioners for Conducting His Majesty's Transport Service for taking care of Sick and Wounded Seamen, and for the Care and Custody of Prisoners of War, as proposed by the Commissioners appointed for Revising the Civil affairs of His Majesty's Navy and established by His Majesty's Order in Council dated the 14th of September, 1808." What full-sounding titles they liked in those days!

The Instructions were printed by the Philanthropic Society, St. George's Fields, in 1809. They fill two fair-sized folios and contain in their appendices sufficient forms and pro-formas to satisfy the most exacting babu.

They are concerned with the management of Prisoners of War "At Home," by which apparently is meant in prisons, barracks, or prison ships, and "On Parole."

They provide for every possible contingency and detail in the lives of the prisoners, even to laying down the kind of coffin to be provided and the funeral expenses which might be incurred in case of death.

On the whole the prisoners appear to have been well cared for ; but the monotony of their lives must have been soul-destroying.

In certain localities agents were appointed to take into their custody all such prisoners of war whether taken at sea or on land, as might be sent to them by the Commanders of any of His Majesty's ships or vessels, or by any other of His Majesty's subjects.

On receipt of such the agent's first duty was to cause their names, qualities, etc., with an accurate description of their persons, to be entered in a general entry book, and to give each individual a number. To prevent imposition with respect to the ranks of prisoners he was directed to ascertain them from the captors of prizes or actuary at the port, if necessary obtaining a perusal of the *Rôle d'Equipage* of the vessel in which they were taken. If the *Rôle d'Equipage* was not forthcoming the agent was to obtain the most reliable information possible from the captains or other superior officers amongst the prisoners with due caution as to its truth.

On the completion of such preliminaries and when the necessary forms respecting the prisoners had been forwarded to the commissioners certain categories were admitted to parole. These were as follows :—

Of Men of War	Admirals. Chefs de Division or Commodores. Captains. Lieutenants. Ensigns. Aspirants or Midshipmen. Surgeons. Aides—Commissaires or Pursers. Secretaries. Chaplains, Instituteurs or Schoolmasters.
Of the Land Service	Every officer having a commission not lower than Sous-Lieutenant. Commissaires and Secretaries. Surgeons.
Of unarmed Merchantmen of 80 tons and upwards.	Masters or first Captains. Chief Mates or second Captains. Surgeons.
Of Privateers having actually on board at the time of capture 14 carriage guns or more mounted (*N.B.*—A carriage gun was everything from a four-pounder upwards.)	Captains. Two other officers, according to seniority on the *Rôle d'Equipage*, for every hundred men on board at the time of capture. Surgeons.

Prisoners who signed the parole engagement were despatched to the locality selected for their residence after due notice had been given to the Commanding Officer and Parole Agent of the district concerned. They were given a time limit in which to report at their destination, and were furnished with the necessary passports and certificates. On arrival they delivered up their swords and other weapons to the agent. Subsistence allowance was given them at the rate of 1s. 6d. a day for each commissioned officer in the Navy or Land Forces, and 1s. a day for others. The officers of Merchantmen and Privateers were not considered as commissioned officers.

In the event of a prisoner on parole becoming so ill as to require the services of a nurse, further sums of 1s. 6d. and 9d. respectively were added to these allowances, provided that the necessity was certified by the surgeon appointed to the medical care of the prisoners. An additional 6d. a day was added for the first twelve days in the case of a patient suffering from smallpox.

All letters to or from prisoners passed through the agent's hands and the strictest supervision was exercised over their behaviour whilst on parole. On the other hand agents were authorized to protect them from insult or maltreatment by the local inhabitants.

They might only be absent from their lodgings between specified hours in the morning and evening, which varied with the season of the year; and persons were engaged at a daily rate of 9d. to ring a bell throughout the town at the times stated. No prisoner might change his lodgings nor any inhabitant receive him without the written permission of the agent.

One mile along the turnpike roads from the extremity of the town was the limit of a prisoner's liberty.

A reward of one guinea was given to persons apprehending prisoners who broke their parole.

If a prisoner died his funeral was performed in the most economical manner consistent with decency. "A plain elm coffin, but no gloves, hat-bands, or any other expense whatever which can be avoided, and the funeral charges are in no case to exceed the sum of two guineas, unless the other prisoners choose to defray the expenses thereof." The agent for his trouble in this respect was allowed a commission of five per cent.

Prisoners other than those on parole were accommodated in barracks, prisons or prison ships. The domestic offices were carried out by persons selected from their numbers. The living arrangements though plain seem to have been sufficient. Those in health were victualled under the inspection of a steward in messes of six men, every mess being supplied with one large wooden bowl, one wooden platter, one six-quart tin can, one quart teapot and six wooden spoons.

The dietary for each man was as follows :—

Bread 1½ lb. per day.

Beef $\frac{1}{2}$ lb. on five days a week.
Codfish 1 lb. on Fridays.
Herrings 1 lb. on Wednesdays.
Potatoes 1 lb. on Wednesdays and Fridays.
Greens or turnips $\frac{1}{2}$ lb. on five days a week.
Scotch barley 1 oz. on five days a week.
Onions $\frac{1}{4}$ oz. on five days a week.
Salt $\frac{1}{3}$ oz. on five days a week.

"The bread was to be made of whole wheaten meal, wherein the whole grain is to be reserved, except such part as will not pass through the London and Bristol seam cloth No. 7, usually called eleven-shilling cloth, or what is considered equal to No. 6 patent cloth of fifteen shillings price."

The beef was to be fresh and not bull beef.

When greens or turnips were not procurable 2 oz. of Scotch barley were substituted, as were $\frac{3}{8}$ oz. leeks for $\frac{1}{4}$ oz. of onions. Certain of the prisoners chosen by their comrades were allowed to inspect with the agent or his delegate the rations delivered by the contractor.

Rations might be supplemented by private purchase in a market open daily in the prison. At this market prisoners could sell articles made by themselves, with the exception of "woollen mittens or gloves, straw hats, caps or bonnets, obscene pictures, images or toys, and articles made from prison stores."

Money sent for distribution to prisoners was kept by the agent who made to each a weekly allowance.

Each man was provided with a suit of clothing, including two shirts and two pairs of stockings. This kit was expected to last eighteen months. In the case of wilful damage to clothes or other Government property the individual responsible was put on two-thirds allowance until the damage was made good. For such an offence a prisoner might also be confined in the Black Hole for not more than ten days. Corporal punishment was prohibited.

Barbers were selected from amongst the prisoners in the proportion of one to three hundred men and were paid a wage of 3d. a day. Prisoners were given exercise daily. At stated intervals their wards and bedding were fumigated.

Every man was inspected daily by the surgeon. Such as required hospital treatment were admitted to the prison hospital where they seem to have received care and attention. The surgeon in charge was in residence in the hospital, his appointment being whole time. He was not allowed private practice, nor to absent himself without permission. Assistants were provided as the number of beds required; and a whole time dispenser was appointed. The economy of the hospital was controlled by the agent, but he was not allowed to interfere in purely medical matters.

In ordinary circumstances the nursing staff was provided from amongst the prisoners, one nurse to every ten patients, but in exceptional circumstances the surgeon in charge was permitted to engage outside help.

Case taking appears to have been thorough. Each patient was provided with a bed-card on which were entered the particulars and progress of his illness and the medicines provided for him, etc. These cards were sent daily to the dispensary and returned to the ward when prescriptions had been compounded.

Surgeons were required to report to inspectors and to the Commissioners cases of special professional interest and to bring to notice improvements in the art of surgery or in surgical instruments.

How common epidemic disease was may be surmised from the detailed instructions given as to segregation and disinfection, and as to the treatment of septic wounds.

Contagious disease was at once reported to the agent "that he might give the necessary orders for carefully attending to the established regulations for boiling and purifying their clothing and bedding, etc." The surgeon was expected to suggest such other means as might in his opinion tend to destroy and prevent the spreading of contagion.

Hospital dresses, shirts, and other articles were supplied for prisoners in "Fevers, Dysenteries, or any contagious disorders," and the patients' own clothing was washed and cleaned before return to them. When convalescent they were removed to special convalescent wards. Surgeons were counselled to push vaccination against smallpox, and in the case of objectors to represent "the harmless nature of the operation and the advantages thereof."

Hospital diets were three in number, i.e.:—

Full diet, consisting of 1 pint of tea in the morning for breakfast and a like quantity in the evening, 16 oz. of bread, 16 oz. of beef or mutton, 1 pint of broth, 6 oz. of greens or good sound potatoes, and 2 quarts of small beer.

Half Diet.—Tea morning and evening as above, 16 oz. of bread, 8 oz. of beef or mutton, 8 oz. of greens or good sound potatoes; 1 pint of broth, and 3 pints of small beer.

Low Diet.—Tea morning and evening as above, 8 oz. of bread, 2 oz. of butter, or in lieu of butter 1 pint of milk, ½ pint of broth or such additional quantity thereof, as the physicians or surgeons shall judge proper.

In special cases on the recommendation of the surgeon or physician, eggs, fish, fowl, etc., were substituted.

The several drinks provided for patients, e.g., toast water, water-gruel, vinegar whey, balm and sage tea, were issued from the dispensary.

The returns relating to prisoners of war both in and out of hospital appear to have been very numerous and detailed. A peculiar feature was that all those dealing with expenditure of public stores, money drugs, etc., were accompanied by an affidavit by the officer who signed them, for which a fee of one shilling was allowed.

Agents, surgeons, assistant surgeons, and dispensers had to take a solemn oath on appointment, and surgeons in addition furnished a bond in three times the amount of their salary.

Reviews.

GONORRHŒA. By David Thomson, O.B.E., M.B., Ch.B.Edin., D.P.H. Camb., with contributions by David Lees, D.S.O., M.D., F.R.C.S.E.; Claud H. Mills, M.R.C.S.Eng., L.R.C.P.Lond.; Robert Thomson, M.B., Ch.B.Edin.; Kenneth Maclachan, M.B., Ch.B.Edin. London: H. Frowde, Hodder and Stoughton, 1923, pp. xiv. and 519. Price 42s. net.

An enormous amount of energy has obviously been expended on this treatise in collecting data, card-indexing and on bibliographic activity. The author has said practically all that can be said on the pathology and bacteriology of gonorrhœa, but has a bias in favour of detoxicated vaccines. The chapter on the abortive treatment of gonorrhœa is good and complete, but the chapters on the clinical manifestations and practical modern treatment of gonorrhœa do not appear to be full or complete enough for a work of this size. The coloured and black and white illustrations are excellent and the general get-up of the book reflects great credit on the author and publisher. F. C. D.

WITH THE FORTY-FOURTHS: BEING A RECORD OF THE DOINGS OF THE 44TH FIELD AMBULANCE (14TH DIVISION). London: Spottiswoode, Ballantyne and Co., Ltd., 1922. Demy 8vo. 5s.

Those who happened to be in the United Kingdom at the time, and who remember the anxious and stirring days of the autumn of 1914 and the following winter and spring will appreciate the difficulties associated with the building up of the various field ambulances which were destined to be the medical units of the ever to be revered divisions of Kitchener's new Army. The 44th Field Ambulance was one of the earliest of these and ultimately found its place in the 14th Division, although at one time its *cadre* nearly became the 26th Field Ambulauce of the 8th Division. This small volume is a chatty and interesting account of its history and doings, tracing its many wanderings, hardships and relaxations through the muddy, precarious days of the Ypres salient, in 1915, the Somme in 1916, the fretful days near Arras in early 1917, more of Ypres in the autumn of that year, and the tragic days of the great fall-back in March and April of 1918. After this, in consequence of casualties, the 14th Division became a B division, and once more Ypres gave hospitality to the 44th Field Ambulance until the great advance enabled it to reach Turcoing, where it may be said the unit became but a shadow of its old self preparatory to dispersal in July, 1919.

For an outsider reading this cheery record it is difficult to follow all the allusions. To appreciate them one must have been a member of the unit. But it is clear that the 44th Field Ambulance was a happy unit, actuated not only by a keen sense of duty, but well endowed with comradeship and *esprit de corps*. In this we do not think it enjoyed a monopoly,

for they were features of most of the field ambulances. It too suffered many casualties, and this little volume gives not only the names of their fallen, but also a full nominal roll of all those who were on its strength from 1914 to 1918. That the unit had its share of casualties is shown by the fact that thirty-one were killed and ninety-eight wounded while with it. To those who served in the 44th Field Ambulance we feel sure that this record of its doings will be welcome, and we congratulate Mr. F. T. Barrett upon his effort to keep alive the memory of the days when he and his comrades played worthily their part in that most wonderful creation the "New Army" of 1915-16, and be able as he says in the words of Shakespeare "to smile at escapes and perils overflown."

R. H. F.

MANUAL OF INSTRUCTION FOR THE ROYAL NAVAL SICK BERTH STAFF. By George O. M. Dickenson, M.B., B.S., Durham, Surgeon Commander R.N. Published by His Majesty's Stationery Office. Pp. viii and 529. Price 2s. 6d. net.

An excellent, concise and comprehensive book, which embodies anatomy—physiology—medical and surgical diseases and other useful general information. Although intended for sick berth attendants, and necessarily containing much that applies specially to the Naval Service (drill, etc.), it should prove of great usefulness to N.C.O.s and men anxious to qualify for the higher qualifications of Nursing Orderly, Class I, and Trained Nurse.

Although the actual section on nursing has only been treated in a very general way, and no references will be found bearing on special nursing, yet, the chapters on the common diseases themselves are excellent, and should prove of interest and value to such N.C.O.s and men.

The book is well edited and illustrated. It has an excellent index which must serve as a most useful reference.

Correspondence.

WAR INJURIES OF THE FUNDUS OCULI.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—Accommodation having been found for the drawings which I made of War Injuries of the Fundus Oculi, I have deposited them in the Army Medical War Museum at the Royal College of Surgeons.

Sir Arthur Keith suggests that a note to this effect might appear in your Journal, so that those interested might be able to examine the drawings at their leisure.

There is a descriptive catalogue, and each drawing has a diagram showing the direction of the projectile which caused the wound.

I am,
Yours faithfully,
W. WALLACE, M.D.
Late Temporary Captain, R.A.M.C.

11, *Ladbroke Road, W.*11.
November 19, 1923.

INDEX TO VOLUME XLI.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subcriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to THE HON. MANAGER, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," WAR OFFICE, WHITEHALL, S.W. 1.